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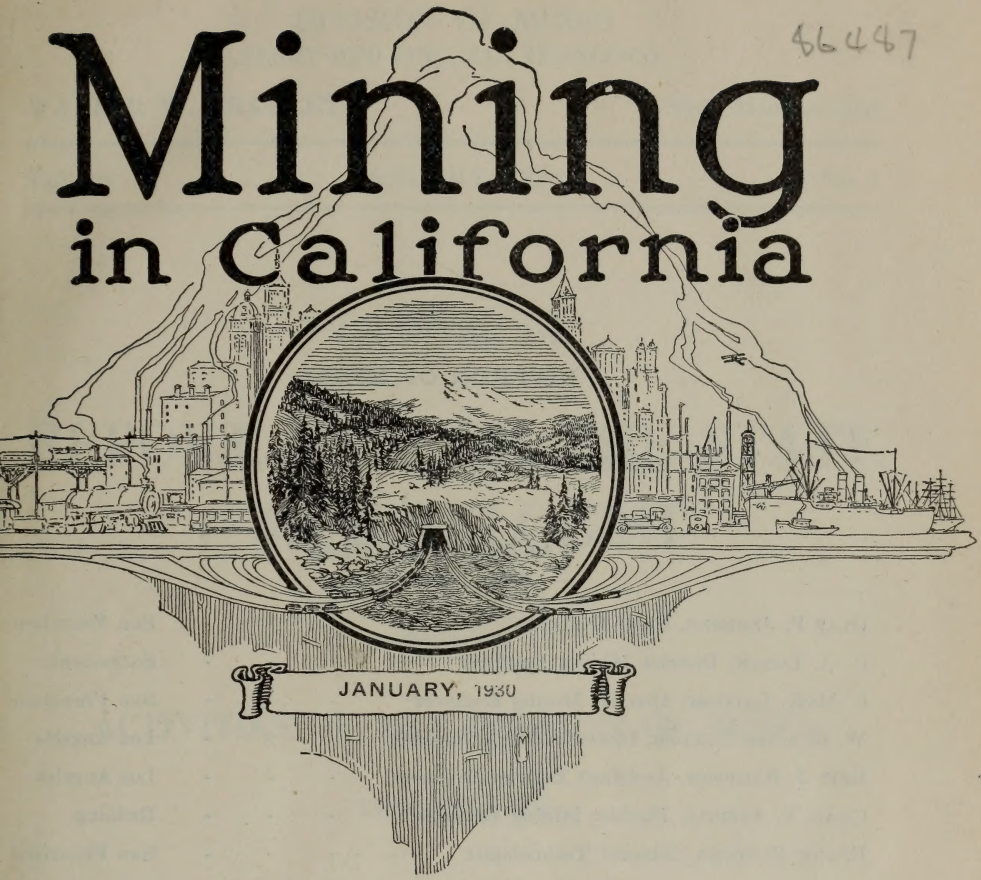

PUBLISHED QUARTERLY

STATE OF CALIFORNIA
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF MINES

FERRY BUILDING
SAN FRANCISCO

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State Mineralogist

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STATE OF CALIFORNIA
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF MINES
FERRY BUILDING, SAN FRANCISCO

WALTER W. BRADLEY — State Mineralogist

Vol. 26 — JANUARY, 1930 — No. 1

CHAPTER OF

REPORT XXVI OF THE STATE MINERALOGIST

COVERING

ACTIVITIES OF THE DIVISION OF MINES

INCLUDING THE

GEOLOGIC BRANCH

CALIFORNIA STATE PRINTING OFFICE
SACRAMENTO, 1930

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PREFACE

The Division of Mines (formerly State Mining Bureau) is maintained for the purpose of assisting in all possible ways in the development of California's mineral resources.

As one means of offering tangible service to the mining public, the State Mineralogist for many years has issued an annual or a biennial report reviewing in detail the mines and mineral deposits of the various counties.

The weak point in work of this character has been that the results of field investigations were so long in preparation that they had lost much of their usefulness by the time they finally appeared in print.

As a progressive step in advancing the interests of the mineral industry, publication of the Annual Report of the State Mineralogist in the form of monthly chapters was begun in January, 1922, and continued until March, 1923.

Owing to a lack of funds for printing this was changed to quarterly publication, beginning in September, 1923.

For the same reason, beginning with the January, 1924, issue, it has been necessary to charge a subscription price of $1 per calendar year, payable in advance; single copies, 25 cents apiece. 'Mining in California' will continue to be sent without charge to our exchange list, including schools and public libraries, as are also other publications of the Division of Mines.

Pages are numbered consecutively throughout the year and an index to the complete reports is included annually in the closing number.

Such a publication admits of several improvements over the old method of procedure. Each issue contains a report of the current development and mining activities of the state, prepared by the district mining engineers. Special articles dealing with various phases of mining and allied subjects by members of the staff and other contributors are included. Mineral production reports formerly issued only as an annual statistical bulletin are published herein as soon as returns from producers are compiled. The executive activities, and those of the laboratory, museum, library, employment service and other features with which the public has had too little acquaintance also are reported.

While current activities of all descriptions will be covered in these chapters, the practice of issuing from time to time technical reports on special subjects will be continued, as well. A list of such reports now available is appended hereto, and the names of new bulletins will be added in the future as they are completed.

The chapters will be subject to revision, correction and improvement. Constructive suggestions from the mining public will be gladly received, and are invited.

The one aim of the Division of Mines is to increase its usefulness and to stimulate the intelligent development of the wonderful, latent resources of the State of California.

State of California
DIVISION OF MINES
WALTER W. BRADLEY
STATE MINERALOGIST
OUTLINE MAP
OF
CALIFORNIA
SCALE
OREGON
NEVADA
PACIFIC OCEAN
MEXICO
DEL NORTE
CRESCENT CITY
HUMBOLDT
EUREKA
ARCATA
SISKIYOU
MODOC
ALTURAS
MT. SHASTA
SHASTA
TRINITY
WEAVERVILLE
REDDING
LASSEN
SUSANVILLE
TEHAMA
RED BLUFF
PLUMAS
QUINCY
GLENN
BUTTE
CHICO
OROVILLE
SIERRA
MENDOCINO
WILLITS
UKIAH
COLUSA
LAKE
LAKEPORT
YUBA
MARYSVILLE
NEVADA
NEVADA CITY
YOLO
WOODLAND
DAVIS
SACRAMENTO
EL DORADO
PLACERVILLE
SONOMA
SANTA ROSA
NAPA
AMADOR
JACKSON
SOLANO
VALLEJO
CALAVERAS
MARIN
SAN RAFAEL
CONTRA COSTA
SAN JOAQUIN
STOCKTON
TUOLUMNE
SONORA
MONO
BRIDGEPORT
SAN FRANCISCO
OAKLAND
ALAMEDA
MODESTO
STANISLAUS
MARIPOSA
REDWOOD CITY
SAN JOSE
SANTA CLARA
MERCED
SANTA CRUZ
HOLLISTER
MADERA
INDEPENDENCE
INYO
SALINAS
SAN BENITO
FRESNO
MONTEREY
HANFORD
VISALIA
TULARE
KINGS
SAN LUIS OBISPO
BAKERSFIELD
KERN
SAN BERNARDINO
SANTA BARBARA
VENTURA
LOS ANGELES
SAN BERNARDINO
RIVERSIDE
ORANGE
SANTA ANA
SAN DIEGO
IMPERIAL
EL CENTRO
•LEGEND•
Mining Division Boundaries.
Mining Division Offices.

DISTRICT REPORTS OF MINING ENGINEERS

In 1919–1920 the Mining Bureau was organized into four main geographical divisions, with the field work delegated to a mining engineer in each district, working out from field offices that were established in Redding, Auburn, San Francisco and Los Angeles, respectively. This move brought the office into closer personal contact with operators, and it has many advantages over former methods of conducting field work. In 1923 the Redding and Auburn field offices were consolidated and moved to Sacramento.

The Redding office was reestablished in 1928, and the boundaries of each district adjusted. The counties now included in each of the four divisions, and the locations of the branch offices, are shown on the accompanying outline map of the state. (Frontispiece.)

Reports of mining activities and development in each division, prepared by the district engineer, will continue to appear under the proper field division heading.

Although the petroleum industry is but little affiliated with other branches of mining, oil and gas are among the most valuable mineral products of California, and a report by the State Oil and Gas Supervisor on the current development and general conditions in the state's oil fields is included under this heading.

New County Reports.

The series of separate reports on the mines and mineral resources of the different counties, that together comprise the State Mineralogist's Reports XIV to XVII, inclusive, in the case of many of the counties have become exhausted. Those still in stock being in need of revision, it was deemed advisable, beginning with the January, 1925, issue of 'Mining in California,' to make the district engineers' reports in the form of a complete general report on the mines and mineral resources in one or more of the counties in each district.

This program has been followed as nearly as possible in succeeding numbers of the quarterly.

REDDING FIELD DIVISION

CHAS, VOLNEY AVERILL, Mining Engineer

There is no report from the Redding Field Division, as Mr. Chas. V. Averill, District Mining Engineer in charge, has been temporarily assigned to field work in the San Francisco and Sacramento Divisions.

SACRAMENTO FIELD DIVISION

C. A. LOGAN, Mining Engineer.

On account of unfinished field work, there is no report from the Sacramento Division in this issue.

SAN FRANCISCO FIELD DIVISION

SANTA CLARA COUNTY

By Herbert A. Franke, Junior Mining Engineer

Introduction.

Santa Clara County lies in the west-central portion of the state. It is bounded on the north by San Mateo and Alameda counties, on the east by Stanislaus and Merced, on the south by San Benito, and on the west by Santa Cruz and San Mateo. The area of the county is 1328 square miles. It was created February 18, 1850. The estimated population, June 30, 1929, was 139,806, while the 1920 census showed 100,676. Its assessed valuation in 1927 was about $129,813,207.

The county seat, San Jose, with an estimated population of 54,461, is 47 miles south of San Francisco, in the heart of the Santa Clara Valley, famous for fruit-growing. The other principal towns are Palo Alto, Santa Clara, Gilroy and Los Gatos. Among the educational institutions found in the county are Leland Stanford Jr. University, Palo Alto; the State College, San Jose; and Santa Clara University, Santa Clara.

Topography and Geology.

The chief topographic feature of the county is the great central valley, comprising nearly one-half of the entire county, which extends through from San Francisco Bay southeastward and on into San Benito County, a distance of nearly 100 miles. Two parallel mountain chains, part of the Coast Range Mountains, lie on either side of the valley. The westerly group, known as the Santa Cruz Mountains, separates Santa Clara Valley from the sea, and is a series of abrupt ridges whose peaks range in elevation from 2000 to 3000 feet. It is in general well timbered with oak, pine and redwood. The easterly group, which separates the smaller valley from the San Joaquin Valley, consists of several parallel ridges, between which are located other small but fertile valleys. The highest of these ridges culminates in Mount Hamilton, whose elevation is 4209 feet above sea level. These ridges contain only a scattered growth of oak, which is also the condition of the main valley.

Rocks belonging to the Franciscan group is the oldest geological formation found within the county. Its age has not been positively determined, but it is generally accepted as Jurassic.[1] It comprises the metamorphosed sandstones, cherts, and serpentines, which make up practically the entire eastern mountain group and the low foothills bordering the west side of the valley. A limited area of marine sandstones and shales, which have been identified as Cretaceous, overlies the Franciscan group southeast of San Jose. In the western part of the county, the Franciscan formation is overlain by heavy-bedded sandstones of the Miocene, which produces the comparatively rugged topography of the bold ridge which separates Santa Clara and Santa Cruz counties. The Quaternary formation is represented by the unconsolidated sands, gravels and clays (detritus of the older formations) which fill the valley bottom. Very few eruptive rocks are found in the county. Rhyolite occurs in the vicinity of the New Almaden Mine, southeast of

[1] Lawson, Andrew C., U. S. Geological Folio No. 193.

San Jose. Its occurrence was first described by G. F. Becker of the United States Geological Survey.[2] A few narrow basalt dykes are exposed along Coyote Creek east of Madrone Station.

Streams.

Santa Clara Valley has a notable peculiarity in that it is divided transversely by a scarcely noticeable soil-covered divide, whose summit is reached near Perry (elevation 345 feet). The southern portion is drained by the Pajaro River, but the northern portion drains through Coyote Creek directly into San Francisco Bay, and the alluvial plain is continuous across the divide. Coyote Creek, the chief drainage system of the county, rises in the mountains near the eastern boundary in the center of the county and flows southerly until it breaks through one range of hills south of Gilroy Hot Springs; thence northerly to a point three miles east of Madrone Station, whence it cuts through another range of hills and enters the Santa Clara Valley, flowing northwestward to San Francisco Bay. Los Gatos Creek rises in the Santa Cruz Mountains and flows northeastward, joining the Capitancillos or Guadalupe Creek at San Jose, whence it also flows northward to the bay. Los Gatos Creek and its tributaries form the main water supply for San Jose and Santa Clara. The northeastern part of the county is drained by Alameda Creek and its tributaries, which enters the bay below Niles. The Arroyo de las Llagas, Uvas Creek and San Felipe Creek are branches of Pajaro River, which flows westward into Monterey Bay. The numerous wells sunk throughout the length of the valley supply ample water for local use.

Transportation.

The coast line of the Southern Pacific railroad traverses the county throughout its length almost centrally, affording easy access to San Francisco and Oakland. A branch line runs from San Jose, via Los Gatos, to Santa Cruz. The Peninsula Railroad Company operates an electric system between San Jose and Palo Alto, via Los Altos, connecting with Los Gatos and Saratoga, and giving access to several small towns in the northwestern portion of the county. The Patterson and Western railroad has been discontinued.

The State highway passes through the broad, fertile valley, running parallel to the main line of the railroad much of the way. Practically the entire county is accessible over paved or improved roads. However, there are only a few mountainous roads which traverse the county east of the Mount Hamilton Range. The Arroyo Mocho road south of Livermore, Alameda County, is the only one leading into the mineralized Red Mountain district.

Mineral Resources.

Santa Clara County, essentially an agricultural county, reported a mineral output for 1928 of $1,021,541. It is the largest producer of magnesite in the state. The county's chief product from a commercial standpoint was miscellaneous stone which includes crushed rock of all kinds, sand and gravel. Other mineral substances found in the county are bituminous rock, brick, chromite, clay, copper, diatomaceous earth,

[2] Monograph XIII, Geology of the quicksilver deposits of the Pacific Slope.

limestone, manganese, mineral water, petroleum, quicksilver and salt. For many years this county was the largest producer of quicksilver in the state, and it is distinguished in that the New Almaden mine was the first producing quicksilver property in North America.

ASPHALT AND BITUMINOUS ROCK

The asphalt and bituminous rock deposits of Santa Clara County have been fully described in previous reports of this division from which the following brief description is extracted:

"The bituminous deposits and springs in the southwest corner of Santa Clara County occur in the foothills forming the eastern slope of the Santa Cruz Mountains. They are principally developed upon the Sargent Ranch, about 3 miles from Sargent Station, on the Southern Pacific Railroad. They are more or less distributed over about sixty acres, although the principal outcrop of the bitumen-soaked strata are confined to an area of a few acres, within which most of the tar springs occur. At this point the shales are light in color when not stained with bitumen, and resemble those in the foothills upon the western side of the Santa Cruz Mountains. A tunnel has been run for a short distance in this formation, but is now caved in. The shales are overlaid by sandstone. About 150 feet down the mountain, and distant perhaps half a mile, are several tar springs exuding from a serpentine formation."

There has been a small production from the above deposits, but not in recent years as this natural asphalt could not compete with that produced as a by-product in the oil refineries.

Bibl: State Mineralogist's Reports VII, p. 93; VIII, p. 548; X, pp. 607–609; XIII, p. 43; XVII, p. 182.

CHROMITE

Chromite occurs in small irregular kidneys and seams in serpentine areas of Franciscan rocks in the Red Mountain District in the extreme northeastern part of the county; in the hills above Alum Rock Park; and in the district 8 miles southeast of Los Gatos. The occurrences are rather limited and the ore is generally too thinly disseminated, or too low-grade to be of commercial value. It is stated that some ore was shipped from the district southeast of Los Gatos over forty years ago.

Kilday Ranch Deposit. Several small lenses of chromite have been developed on this property which lies along the top of a ridge, probably 1000 feet in elevation above Guadalupe Cañon and 8 miles southeast of Los Gatos. The ridge here is capped with a decomposed serpentine, and chromite has been found in several different places, but thus far no large deposit has been uncovered, and there is very little ore now exposed. About eighty tons of the ore was shipped out by the Farish Company, Insurance Exchange Building, San Francisco, during 1916, but no work has been done since.

Laurel Lake Ranch Deposit. J. A. Ferbrache of Gilroy developed a deposit of high-grade black chromite on this property 7 miles northwest of Gilroy. The serpentine in which the chrome ore occurs outcrops prominently along the ridge south of Uvas Creek. Associated with the serpentine is a peridotite, thin sections of which have been

limestone, manganese, mineral water, petroleum, quicksilver and salt. For many years this county was the largest producer of quicksilver in the state, and it is distinguished in that the New Almaden mine was the first producing quicksilver property in North America.

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SANTA CLARA COUNTY—MINERAL PRODUCTION 1850-1928.

Year	Quicksilver		Mineral water		Petroleum		Brick		Pottery clay		Sandstone		Limestone		Miscellaneous stone, value	Magnesite		Miscellaneous and unapportioned		
	Flasks	Value	Gallons	Value	Barrels	Value	M	Value	Tons	Value	Cubic feet	Value	Tons	Value		Tons	Value	Amount	Value	Substance
1850	7,723	$708 052																		
1851	27,779	1 859 248																		
1853	16,901	927 505																		
1853	22 384	1 235 648																		
1854	30 004	1,663,722																		
1855	29 142	1,560 594																		
1856	27,138	1,401 678																		
1857	26,204	1 374 381																		
1858	25,761	1 232 149																		
1859	1 294	81 690																		
1860	7,061	378 117																		
1861	34 429	1,447 739																		
1862	39 671	1 442 041																		
1863	32 803	1,380,350																		
1864	42 489	1,950 245																		
1865	47 194	2 166 205																		
1866	35 150	1 867 519																		
1867	24 461	1 122 760																		
1868	25 628	1 176 325																		
1869	16 [illegible]	775 [illegible]																		
1870	14 423	827 592																		
1871	18,568	1 171 641																		
1872	18,674	1 224 584																		
1873	11,042	887 008																		
1874	9,084	995 455																		
	20,000	1 098 000																		
1875	16,980	1 428 867																		
1876	27,930	1 228 920																		
1877	30,237	1 127,840																		
1878	24,924	820 000																		
1879	36,054	1,076 212																		
1880	30,135	934 185																		
1881	31,288	933 321																		
1882	29,208	824 542																		
1883	29,084	836 165																		
1884	20,000	010 000																		
1885	21,400	658 050																		
1886	18,000	639,000																		
1887	20,000	847 600																		
1888	18,000	765 000																		
1889	13,100	589,500																		
1890	12,000	630 000																		
1891	8,200	371 105																		
1892	5,563	226 476																80 000 cu ft	$4,072	Natural gas
1893	6,614	243 064																		
1894	7,235	222 109	5,000	$1,250	3,500	$5,500	22 725	$119,250			24 000	$8,292						500 000 cu ft	12,000	Natural gas.
1895	7,050	253 800	20,000	5,000	4 000	10 000	21 750	131,250							$33,000					
1896	6,222	211,570	44,000	18,800	900	1,145	15,000	80,000					500	$600	5,000				1 300	Natural gas
1897	4,700	169,200	39,500	17 600	4,300	10 000	19 000	105,000												
1898	5,875	235,000	25,863	11 358	3 000	6 000	13,098	65,490	200	$2 500					12,000			32 tons	640	Asphalt
1899	4,435	180,270	79,000	19 150	1,500	3,000	30,741	170 455					1,800	3,000	8,000	100	$1,350	5 tons	75	Manganese
1900	5,145	241 073	30 000	8,060			20,000	136 000	2,000	6,000	120 000	100,000	6,000	6,000		39	253			
1901	5,220	236 608	55 000	8 500			21 800	94,570			60 000	80,000			917	50	300	17 tons	255	Asphalt
1902	5,669	254 260	21 900	5,500			23 982	178,062			35 000	31,500						2 000 cu ft	1 200	Granite
1903	5,603	233 130	50 000	12,500	4 695	3 966	28 069	188 284			112,356	225 000	7,000	7,000	100			21 tons	47	Bituminous rock
																		11 tons	132	Asphalt
1904	3,589	148 103	50 000	12 500	42 000	13 860	24,909	178 581							12 000					
1905	2,693	95 968	5 000	1 200	41,000	14 555	28 458	204 357	700	1,050	100 000	150 000	10,000		3 000					
1906	2,592	94 608	5 000	1 250	7 000	2 800	23 397	183 676	1 000	1,500			9 460	15 000						
1907	2,518	96 486	11 374	2 187	32 100	5 825	30 053	255 424			3 500	3,500	671	10 684		3 700	33 300			
1908	2,460	103,984	371 635	30 955	35 400	17 700	15 000	63 818					2,221	1 417	45,142	2,000	24 000	10,017 bbls	10,017	Lime.
1909	3,747	158,490	373 367	40,754	93 780	76 536	6,000	30,000					4 284	4 150	75,916	300	3 000	1 000 bbls	1,000	Lime
1910	4,038	152 719	152 500	11 200	30 660	16 860	12 000	66 000	12,000	66,000			2 417	3 451	68 765	7 560	51,937		82 254	Unapportioned 1 to 10
1911	7,533	346 591	165 720	10 000	12 825	8 505	6 000	30 000					3 374	3,918	62 595					
1912	8,695	365 535	152 500	10 250	14 092	8 295	18,000	105,000					3,549	4 120	48 228	600	6 000	13 508 bbls	10 154	Lime
1913	3,709	149 213	101 000	10,750	20 000	12 000	18,000	95,000						4 200	29 377	70	560	13 107 bbls	9,783	Lime.
																		2,000 cu ft	500	Natural gas
1914	2,407	118 063	29 000	10 750	10 000	5 300	15,900	79,500							39 093	1 425	14,250			
1915	4,386	370,319	38 400	16 770	16 617	11 067	10 098	57,784					1		93 342	7 623	74 607		340	Other minerals
1916	4,016	375 496	50,000	11 300	16 368	10 901	13 100	82,800	2 024	2 293			1		111 974	23 207	232,156		25 028	Chromite, limestone, manganese
1917	5,921	639 594	10,230	1,023	18 855	26 152	14 000	80,000	6,014	4,929					111 304	9 963	99,287		28 341	Chromite, manganese, tile, limestone
1918	3,977	478 524	13,025	1,678	20 499	34 848	6,792	62 000					1		111 860	9,746	121 872		948,786	Chromite, manganese, clay, tile, potash
1919	3,012	271 762	1		16 724	26 695	7,250	65,000	2,532	2,232			1		73 237	10,912	128,924		480,721	Manganese, limestone, mineral water, potash.
1920	2 893	233 199	3,360	480	16 095	21 901	11 800	164,680	1,900	4,000					129 582	26 612	392,580		89 670	Limestone and potash
1921	1	1	2 500	275	13 464	26,943	7,501	110,961	1 126	2,300			1		136,584	25 800	280,000		191,645	Limestone marl potash quicksilver.
1922	1	1	7 800	326	1	1	11 400	150,057	3 836	7,372			8,252		2 5 1 3 5	28 650	301 875		1 [illegible] 252	Limestone (marl), petroleum quicksilver
1923	1	1	1	1	1	1	22 514	282 997	2 202	3,954			also marble	40 512	314 035	36 360	472 620		196 475	Mineral water, natural gas petroleum quicksilver
1924	1	1	1	1	14 417	20 481	24,271	217,172	5,341	5 666			1		259,023	1			648,050	Limestone magnesite, mineral water, natural gas, quicksilver
1925	1	1	1	1	13 8 8	22 504	24 250	251,059	1 516	3,216			1		453 273				500,718	Limestone magnesite, mineral water natural gas quicksilver
1926	1	1	1	1	1	1			1						478,231	1			197,998	Clay and clay products
																			352 277	Magnesite, mineral water, natural gas, quicksilver petroleum
1927					11 891	11 242	20 254	199 472	4 371	4,281					457 703					
1928	1	1	1	1	13,746	15 121	14,622	157,732	3,058	2,063			1		487,555	1			315 238	Magnesite and mineral water
																			379,070	Limestone, magnesite mineral water, quicksilver
Totals	1 151 176	$54 283 002	1,938 374	$290 316	499,562	$477 262	604,859	$4 441,831	49,822	$119,936	451 850	$568 202	59 528	$119,062	$3 884,761	183 837	$2,109 967		$4,759 095	

[1]Includes crushed rock, rubble, sand, gravel.
[2]See under 'Unapportioned'
[3]Estimated production of Guadalupe Mine previous to 1875.
[4]Erroneously credited to Alameda County in reports of those years.

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examined microscopically and show phases high in olivine, and also approaching augite diorite. Although still retaining its original outlines, much of the olivine is seen to be altered to serpentine. One large boulder was uncovered in the loose soil capping and a tunnel was driven to cut some leaders which occur in the serpentine above. There have been some shipments.

Winship Properties. K. D. Winship, 350 Post street, San Francisco, owner. Chromite occurs on Section 11, T. 6 S., R. 4 E., and on SW¼ of Section 7, T. 6 S., R. 5 E., M. D. M. Holbrook and McGuire, as sublessees in the summer of 1917, shipped several carloads of high-grade chromite from this property. In the latter part of 1918 T. S. O'Brien et al., 200 Pine street, San Francisco, leased Section 11, and built a 50-ton concentrating mill.

Several test runs were made during the first part of February, 1919, and about 25 tons of concentrates were produced, averaging 50% Cr_2O_3. The mill was closed down after this owing to market conditions. It is claimed that there is several thousand tons of milling ore here, which will run around 10% Cr_2O_3.

CLAY

No commercial deposits of high-grade clays are known in the county. Common clays suitable for the manufacture of brick and tile are abundant throughout the valley portions of the county. On account of favorable manufacturing and marketing conditions, a number of clay-working plants have been established in and near San Jose and Santa Clara. Some of these plants use common clay from extensive deposits along Coyote Creek within the city limits of San Jose. The clay bed here is from 15 to 20 feet thick.

Garden City Pottery Company. N. J. Mahon, president; Frank Brown, vice president; Edith L. Gallup, secretary. Office and plant at 560 N. Sixth street, San Jose. This company was established in 1904, under the name of the Garden City Pottery. A local red clay from Coyote Creek is used for flower pots, while Lincoln (Placer County) clay is used for stoneware.

The stoneware mix is prepared by grinding, washing, and filter-pressing, followed by pugging. After shaping, the ware is dried in steam-heated drying rooms for a period of three or four days. Firing is done in four round down-draft kilns. Two of the kilns are 20 feet, and two are 18 feet in diameter. They are fired with oil, which is atomized with steam. The stoneware is fired at 2200° F. (about cone 5) in 72 hours, and the flower pots are fired to 1800° F. (about cone 07) in 48 hours.

The plant operates throughout the year and employs 30 men.

Bibl: State Min. Bur. Bull. 38, p. 229; Prel. Rept. No. 7, p. 96; Bull. 99, p. 219–220; State Mineralogist's Report XVII, p. 184.

Handcraft Tile Company (formerly San Jose Tile Company). L. W. Austin, president; Florence M. Austin, secretary.

The plant has recently been moved from the San Jose site on Coyote Creek to a point a mile and a half south of Milpitas on the Milpitas San Jose highway. Clay from Natoma Clay Company, Sacramento County; Lincoln, Placer County; and Ione, Amador County, is used

largely, although some local clay on the property is used for crude material. The equipment consists of a hammer mill, dry pan, elevators, screens, pug-mill, and two rectangular down-draft kilns. After the clay is prepared by machine the tile are made by hand. The kiln is fired to cone 8 (around 2400° F.) Electric power is used. Hand-made floor, wall and mantle tile are manufactured.

Bibl: State Div. Min. Bull. 99, p. 221.

Kartschoke Clay Products Company. Charles Gladding, president; A. C. Gladding, secretary. Plant at 1098 South Third street, San Jose. The clays are obtained from banks along Coyote Creek, with the addition of some clay that is purchased from the Yaru deposit at Ione, Amador County, and from Lincoln, Placer County.

The clays are ground in a dry pan and elevated to a double-shaft pug-mill from which the mix passes to an American sewer-pipe press. Drying is done in a building which is heated by steam during the winter. Four to five days are usually required for drying.

The ware is fired in four oil-fired round down-draft kilns, 28 feet in diameter. Cone 2 (1165° C.) is reached in 80 to 90 hours, the entire cycle, including setting and drawing, requiring about two weeks. Gas is soon to be installed to replace the oil fuel. Common brick are burned in a Hoffman kiln. About 45 men are employed.

The principal products of the plant are common brick, roofing tile, flue lining, sewer pipe and patent chimney pipe. About 30,000 common brick are produced daily besides 400 tons of other clay products monthly.

Bibl: State Mineralogist's Report XIII, p. 618; XVII, p. 182; State Min. Bur. Prel. Rept. 7, p. 97; Bull. 99, p. 220.

Platt's Premier Porcelain, Inc. H. D. Melvin, president; A. A. Baker, vice president; N. E. Wretman, secretary. Plant on Lafayette street, Santa Clara.

Several years ago sanitary porcelain was made from a mixture of English china and ball clays, Arizona feldspar, and California silica. The plant was idle when visited, January, 1930. The *American Vitrified China Company,* I. N. Poynter, president, of Los Angeles, recently leased the plant and are expected to start operations soon. The installation of gas is planned. Hotel china will be manufactured.

Remillard Brick Company. Mrs. C. Remillard, president; Miss L. Remillard, vice president; Victor Geroux, secretary. Office: 332 Phelan Building, San Francisco. Plant on Story Road, east of San Jose. Common red brick are made of a yellow clay on the property along Coyote Creek. Clay is worked by dragline and hauled to the plant by cable car. It is dumped into a hopper, tempered with water, and then pressed into wooden molds, six bricks to a mold. Green bricks are placed on pallets and conveyed to open air racks to dry. Drying in open racks requires from eight to nine days. A continuous kiln is used, with electric power for operations. The plant employs around forty-two men, but operates for only six months during the year.

Bibl: State Div. Mines Bull. 99, p. 221.

San Jose Brick and Tile Company (formerly San Jose Brick Company). A. G. Rhodes, president; G. L. Richards, secretary. Address:

P. O. Box 274, San Jose. The plant is on Fruitvale avenue, and the property comprises 35 acres. The product is common red brick. The clay deposit consists of a 30-foot bed of red-brown plastic clay overlain by three to five feet of soil. The clay is mined with a Marion electric shovel which dumps the material into a car that is pulled by a Plymouth gasoline locomotive to the plant.

The clay is conveyed up over Hummar vibrating screens and then put in the dry pan and crushed by rollers. A bucket elevator carries the material through another Hummar screen from where the clay is conveyed by belt to the clay bin for storage. After the clay is conveyed from the hopper and through the pug-mill, it passes through an E. M. Freeze K-B brick machine, which has a capacity of 75,000 brick per day and is driven by a 150-h.p. electric motor. A wire cutting machine cuts the brick to the required length. An industrial car system is used in the drying and kiln yard. Drying in open racks requires from seven to eight days. One round down-draft kiln (oil burner) and two Hoffman down-draft continuous kilns are used for firing. Coal screenings are used as fuel in the latter. The firing schedule of the continuous kilns is as follows: three days water smoking, four days firing and ten days cooling. Fired at 2100° F. A brick crusher is also part of the equipment and is used to crush bricks for roofing purposes. The crushed roofing material is sold in 80-lb. sacks. Standard clinker and cherry red bricks are manufactured.

Bricks are made for only eight months during the year, but are burnt the year round. The plant has a capacity of 18 million bricks yearly. Fifty-five men are employed during the summer and twenty-five in the winter.

Bibl: State Div. Mines Bull. 99, p. 221.

S. & S. Tile Company. A. L. Solon and F. P. Schemmel, owners. Office and plant at 1881 South First street, San Jose. Local clay from Coyote Creek is used in conjunction with Lincoln clay and Ione sand. The clay and sand are weighed, mixed and ground and then passed through a rotary screen and to the pug-mill. A Muller auger is used for shaping all plain tile, whereas fancy tile are hand-pressed in plaster molds. Tile is repressed with such designs as needed and dried in a specially designed waste-heat drier. Two oil-fired round kilns, 18 and 22 feet in diameter, respectively, are used to burn the tile. They are fired to 2100° F. for the first burn, then glazed, and again burned at the same temperature. Floor and wall tile are the principal products. About twenty men and eight women are employed.

Bibl: State Div. Mines Bull. 99, p. 221–222.

COPPER

Hooker Creek Mine. Dr. H. C. Adair, Flood Building, San Francisco, owner. Located 7 miles south of Los Gatos, above Aldercroft Heights, and one mile from the station of Eva on the main line of the Southern Pacific railroad. It is near the line between Santa Clara and Santa Cruz counties.

There are four tunnels, No. 1 about 20 feet, No. 2 about 235 feet, No. 3 about 85 feet and No. 4 about 500 feet in length. The present operators began working August 27, 1929. F. L. Schultheis, an

operator, prospected here in 1900. H. C. Homer, another one of the operators, states that an 85-foot highly mineralized zone, mostly chalcopyrite, in No. 2 tunnel was passed through. An assay by Smith Emery and Company on ore from No. 1 tunnel shows 18.13% copper, .82 oz. gold, and .60 oz. silver. The ore is chalcopyrite, azurite and malachite, and some of it is said to run very high in copper. Four men are working.

Bibl: State Mineralogist's Report XVII, p. 184.

DIATOMACEOUS EARTH

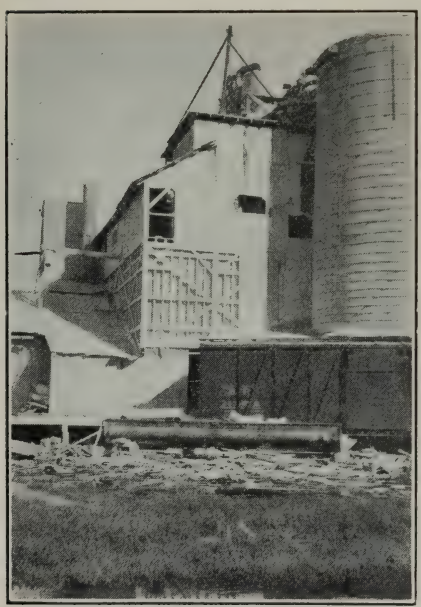
A. L. Atwater, 300 Broadway, San Francisco, reports diatomaceous earth on his property six miles southeast of Los Gatos in Sec. 13, T. 8 S., R. 1 W. Undeveloped.

LIMESTONE AND LIME

Limestone of good commercial grade occurs at several places in the mountains bordering the west side of the Santa Clara Valley, the most important deposits being those in the vicinity of Black Mountain, and in the range extending southeastward from Los Gatos to the Guadalupe mine. The Black Mountain deposits outcrop over a considerable area. The rock is a very high grade limestone, fine-grained and hard, varying in color from yellowish-blue to black.

Bay Shell Company. Home office: 519 California street, San Francisco. Plant located near Alviso. W. T. Monroe, plant superintendent.

This plant has been in operation over six years, pumping their oyster shells out of San Francisco Bay from boats with a rotary pump. The shells are unloaded from the boats to the stock pile by an overhead crane with a traveling clam shell bucket. The shells are later conveyed up to the plant hopper by the crane. After the shells are passed through a 40-foot rotary kiln, fired by oil, they go through a rotary screen, the finer material going to a Williams hammer mill, and the coarser grades through a set of rolls and through three screens, making a fine and medium shell product. The shells that passed through the hammer mill are taken through an air separator, where the fine lime is separated from the coarse and taken to the lime bin to be sacked by machine. Chicken shell, lime for fertilizer and mixed composts are manufactured. The shell runs about 98% $CaCO_3$. A spur line of the Southern Pacific railroad serves the plant. Electric power is used. Eight men are usually employed. Capacity of plant is 1000 tons monthly.



Bay Shell Company's plant at Alviso, Santa Clara County.

Bernal's California Marl Fertilizer Company. Pedro A. Bernal, Edenvale, owner. Property leased by *Consolidated Rock and Product Company* of Los Angeles. This company started operations here in 1921 and employed about eight men, until three years ago when work was discontinued.

This limestone quarry is located on the east slope of the Santa Teresa Mountains, three miles by road southwest of Edenvale. It is irregular in character, grading from a fine-grained hard bluish-gray limestone to a calcareous marl, containing an abundance of shells.

Most of the equipment on the property has been removed, but formerly an excavator, grizzly, screens, and mill for pulverizing the marl were used. The product was sacked at the quarry and hauled to Edenvale, from where it was shipped to consumers for fertilizer.

Bibl: State Mineralogist's Report XVII, pp. 185–186.

Bond Limestone Deposit. A. J. Bond, 564 Twenty-fifth street, Oakland, owner. Eighty acres of undeveloped lime rock is located ten miles by road from Los Altos, in Section 14, T. 7 S., R. 3 W., adjacent to the Winship properties. The following is an analysis as reported by the Cowell Portland Cement Company:

(Authority, advertising matter.)

Silica (SiO_2)		1.08%
Iron Oxide (Fe_2O_3)		0.64%
Calcium Oxide (CaO)		54.99%
Calcium Carbonate ($CaCO_3$)	98.20%	
Magnesium Oxide (MgO)		0.25%
Magnesium Carbonate ($MgCO_3$)	0.52%	
(SO_3)		0.02%
Loss on ignition (H_2O)		43.14%
		100.12%

Bibl: State Mineralogist's Reports VIII, pp. 543–546; X, p. 619; XII, p. 394; XIII, p. 630; XVII, pp. 184–185. Bull. 38, pp. 82–83.

W. B. Ortley Shell Company. Plant located at Alviso. The oyster shells are pumped out of San Francisco Bay by a rotary pump on a barge and brought to the unloading wharf at the plant by boat, and are left in the stock yard several days to dry. The shells are then elevated to the plant by means of a slip scraper (slusher). They are fed through a rotary kiln, fired by natural gas, and then elevated by a bucket conveyor and taken through the rotary screen where the shell is graded. The coarse shell is taken through the rolls for crushing and again conveyed up and through the rotary screen. The shell is sacked and sold for poultry feed. Electric power is used. Three men are employed.

Santa Clara Holding Company's Quarry, formerly known as the Alameda Sugar Company's Quarry. This limestone quarry is located nine miles by road from Mountain View, in Secs. 17 and 18, T. 7 S., R. 2 W. It has been idle for some time.

San Jose Cement Company, formerly known as the Guadalupe Portland Cement Company. Office: 919 Balboa Building, San Francisco. This company owns a deposit of 331 acres of undeveloped limestone about six miles south of Los Gatos, in Secs. 4 and 5, T. 9 S., R. 1 E., and in Sec. 32, T. 8 S., R. 1 E., M. D. B. & M. A gray-black limestone is

Plant of Maltby Magnesite Mines, Santa Clara County, 33 miles southeast of Livermore. Photo by courtesy of C. S. Maltby.

exposed here, assaying about 54% calcium oxide, which is equivalent to about 96% calcium carbonate. The estimated tonnage available is about 75 million tons. A volcanic slag is also found on the property.

Winship Properties. K. D. Winship Estate, 350 Post street, San Francisco, owners.

The following analysis is of an average sample of the limestone taken by W. W. Bradley of this division from croppings on the southwest flank of the mountain, in SW¼ Sec. 13, T. 7 S., R. 3 W.

(Analyst, Sidney A. Tibbetts, Berkeley.)

Silica (SiO_2)	1.56%
Aluminum oxide (Al_2O_3)	0.47%
Iron Oxide (Fe_2O_3)	0.22%
Manganese oxide (Mn_3O_4)	0.05%
Phosphoric oxide (P_2O_5)	0.06%
Calcium carbonate ($CaCO_3$)	97.20%
Magnesium carbonate ($MgCO_3$)	0.43%
Total	99.99%

These deposits suffer the disadvantage of being over 9 miles from the railroad, but they are accessible by wagon road. A railroad, however, could easily be built up the cañon of the South Fork of Permanente Creek to the foot of Black Mountain.

Bibl: State Mineralogist's Reports VIII, pp. 543–546; X, p. 619; XII, p. 394; XIII, p. 630; XVII, p. 185. Bull 38, pp. 82–83.

MAGNESITE

Magnesite deposits occur in the serpentine areas in the eastern portion of the county, the largest and best grade deposits thus far uncovered being those at Red Mountain in the northeastern corner of the county. These deposits have long been known and many attempts made to develop them, but their distance from the railroad, and the uncertainty of a market, long delayed their exploitation; and it is only within the last decade that they have been put upon a commercially producing basis.

A number of magnesite croppings occur at irregular intervals in a belt of soft impure serpentine along a low range of hills bordering the east side of the Santa Clara Valley, extending from east of Coyote Station to Gilroy. These croppings are small, and the magnesite is less pure than the Red Mountain deposits, being mixed to some extent into the serpentine, and varying in color from white to buff. Several of these deposits have been developed, and during 1916–1918 considerable crude magnesite was shipped out. They have the advantage of being within easy access of the railroad.

Maltby Magnesite Mines, formerly known as: *Western Magnesite Development Company, Standard Magnesite Company* and *Pacific Magnesite Company.* H. E. Stock, president; Herbert Erskine, secretary. C. S. Maltby, Humboldt Bank Building, San Francisco, has leased this property, located mainly in T. 6 S., R. 5 E., M. D. B. & M., along the summit of Red Mountain ridge which forms the boundary line between Santa Clara County and Stanislaus County, to the east, and operated it since 1919. W. T. Lewis is superintendent of the mines.

The magnesite outcrops in bold white ledges on the southern and western slopes of Red Mountain, 600 to 700 feet above the floor of the

valley. The magnesite is in general high grade, though towards the border of the large bodies it becomes mixed with the soft serpentine country rock, having a yellowish color, so that there is no well-defined boundary. A description of the geology is quoted from the report of Gale,[1] who made an examination of the deposits in September, 1912, in Bull. 79 of this division, page 83.

The earlier underground operations were due east from the furnaces, and some ore is still being drawn from that portion of the property. Later developments have been toward the north and southeast from the older workings. New orebodies are continually being developed. The most prolific producer up to the present time has been the White Diamond Group.

An aerial tramway at the north end has been installed in order to eliminate the long haul around the hill. A No. 4 tramway is being put on the southeast properties, known as the old Pacific Properties. The larger and heavier of the four tramways to the main south workings is 3000 feet long with a drop of 550 feet from ore bins to furnaces.

A total of 100–300 tons of ore per day is being delivered to the furnaces. Two new tunnels have been started on the southeast properties. Electric power has been installed and an Ingersoll-Rand, 2-stage compressor, capable of producing 1000 cu. ft. per min. Four upright kilns are used to burn the lump ore, and a rotary kiln, with a crushing plant, for calcining the fines. The burners used on the upright kilns have 2, 3 and 4 tips in order to spread the flame, while the rotary has a duplex burner of the company's own make which has been very satisfactory. The dismantling of the Scott furnace was begun in 1929 and large storage bins are being erected on its site. The ore as it comes from the mine is dumped on grizzlies set with 1¼-inch opening, and the through material passes over a ¾-inch screen. The plus ¾-inch material goes to the rotary kiln and the minus ¾-inch to the waste dump, as it contains mostly impurities. A Thwing electric pyrometer on the rotary kiln is used to maintain a constant temperature. The upright kilns are drawn every 2 hours, and their output totals 50 tons daily for the four. The burned lump ore is carried by a belt conveyor to a trommel with 1-inch apertures. The waste and off-colored magnesite are picked off the belt. The unburned cores after passing out of the trommel are hauled back to the main ore bin and reburned in the kilns. Air for atomizing the fuel oil is provided by a 27-h.p. G. E. blower, centrifugal type. Since the electrification of the plant in 1926 the boilers have been discarded except for heating purposes, etc. The Pacific Gas and Electric Company are considering the installation of natural gas lines to the property from their Kettleman Hills line which goes through Patterson Pass.

Fourteen motor trucks are in service, hauling the calcined magnesite to the railroad at Livermore, which is 33 miles by road northwest of the mines. On the return trip they bring in fuel oil in drums. About 90 men are employed. This company produces plastic, dead-burned and crude magnesite. Periclase, a new product in the magnesite industry, is being produced regularly and this new product should prove quite a factor in that industry.

[1]Gale, H. S., Magnesite Deposits in California and Nevada; U. S. Geol. Sur., Bull. 540 pp. 498-501, 1914.

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Underground workings in White Queen Group of Maltby Magnesite Mines. Photo by courtesy of C. S. Maltby

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O'Connell Bros. Ranch (formerly Weber Ranch). O'Connell Bros., Sixth and St. James, San Jose, owners. This ranch extends over an area of several square miles, and contains two groups of magnesite deposits which are designated the 'north' and 'south' groups, respectively.

The north group is located on an open ridge, about three miles in an air line northeast of Madrone. A few carloads were shipped by H. Sherlock during 1915 to Berkeley for the manufacture of carbon dioxide, and during 1916 some further development work was done by the Water Company under the management of H. L. Haehl of San Francisco, but the deposits found were too small to warrant exploitation, and work ceased. On the west slope of the hills near the top, a deposit was later developed under lease by H. C. Warwick of San Francisco, followed by a Mr. Madison. A large open cut shows a ledge of white to buff-colored magnesite. Several hundred tons have been produced from this deposit. An aerial tram conveyed the ore to a bunker at the foot of the hill, whence it was hauled by truck to the railroad at Madrone.

On the east slope considerable float has been found and several large cuts were made in the hope of striking the ore in place. The magnesite occurs here in bunch-like or kidney deposits, being evidently not deposited in a vein or lode, but as a general alteration of the serpentine with which it is closely associated. The slopes of the ridge are covered with an adobe soil, and the serpentine very much decomposed, but the development work indicates these deposits are in place. The kidneys or boulders are white and evidently quite pure.

The property has been idle since 1919. The formations uncovered in the several openings indicate that the magnesite occurs in small irregular veins, in part reticulated, and some irregular masses. In the upper workings near the top of the ridge the magnesite is more massive, but also irregular.

The magnesite in the south group of the deposits on the O'Connell ranch is distinctly different in character from that in the north group described above. It outcrops in large, rugged masses for at least a mile along the eastern side of a ridge which trends northward between Coyote Creek and the main Santa Clara Valley east of Madrone. It is three and one-half miles by road from Madrone. Idle.

Winship Properties. K. D. Winship Estate, 350 Post street, San Francisco, owner. Magnesite occurs on Secs. 1 and 2, T. 6 S., R 4 E., and on the SW¼ of Sec. 7, T. 6 S., R. 5 E., M. D. M.

Bibl: State Mineralogist's Reports XIII, p. 505; XVII, p. 188. Bull. 38, p. 331; Bull. 79, pp. 79 and 87. U. S. Geol. Surv. Bull. 355, p. 31.

There are numerous other magnesite deposits in this county, worked somewhat during the World War, but now idle, some of which are:

Bradford Ranch Deposit, 4 miles southeast of Edenvale, along the top of an open rolling ridge. Herbert S. Bradford, San Jose, owner.

Bibl: State Mineralogist's Report XVII, p. 187; Bull 79. p. 78.

Burnett Ranch Deposit. Near top of ridge one-quarter mile north of the Metcalf road, and three miles northeast of Coyote Station.

Bibl: State Mineralogist's Report XVII, p. 187; Bull. 79, pp. 78–79.

Cochrane Ranch Deposit (also known as the Jackson Ranch Deposit) is four and one-half miles east of Madrone Station, and one and one-half miles south of the junction of Coyote and San Felipe creeks.

Bibl: State Min. Bur. Bull. 79, p. 79.

MANGANESE

Manganese ores occur in the mountainous area in the extreme northeast corner of the county, bordering Alameda, San Joaquin, and Stanislaus counties. They occur in the form of oxides in the jasper lenses of the Franciscan formation. This formation, consisting of heavy bedded sandstone, shale and conglomerate, more or less metamorphosed, is intruded by many different igneous rocks. The manganese deposits are very irregular, varying in size from stains and small veins in the chert to comparatively large pockets. The ore varies from soft and powdery to hard and massive. In discussing the origin of these manganese deposits, E. C. Harder[1] writes as follows:

"The manganese ores in the Franciscan jaspers in their present form are clearly secondary concentrations, as is shown by their replacement of jasper and by the intimate association of manganese oxide and quartz veins, suggesting their contemporaneous deposition. That the jasper itself is the source of the ore is shown by the facts that it is invariably associated with the ore deposits throughout the Coast Ranges, and that ores do not occur in the sandstones and shales of the formation."

This theory, however, is now regarded by many as erroneous and the manganese beds are believed to have been deposited with the chert, and to have been altered, in place, from the carbonate or silicate to the oxide, by the action of water and other agents.

Comparatively little ore was shipped from the different deposits prior to 1916. The high price of this metal during the war period led to some renewed activity, but at present none of the properties are being developed.

Lopez Prospect. Alfred Lopez, Route 1, Morgan Hill, reports a manganese deposit, one mile west of Madrone Station on the Rainey Ranch. He expects to mine this deposit soon.

Some of the manganese properties that were active during the war period, but now idle, are: (For detailed information, see our Bulletin No. 76, pp. 75–80; State Mineralogist's Report XVII, pp. 192–197.)

Ala Mountain Mine, is twenty-six miles southeast of Livermore in Section 28, T. 5 S., R. 4 E., M. D. M.

Black Bear Mine, twenty-five miles southeast of Livermore, is in Section 34, T. 5 S., R. 4 E., M. D. M., near the summit of the west slope of the Arroyo Mocho Valley, at an elevation of 3100 feet.

Black Bird Prospect, is in the center of Section 28, T. 6 S., R. 5 E.

Black Wonder Properties, comprises the Jones Group in the $NW\frac{1}{4}$ of $NE\frac{1}{4}$ of Section 27; the Black Wonder in the $SE\frac{1}{4}$ of $SE\frac{1}{4}$ of Section 27; and the Mexican Prospect, in $SW\frac{1}{4}$ of $SE\frac{1}{4}$ of Section 27, T. 6 S., R. 5 E., near the Stanislaus County boundary.

Bibl: U. S. Geol. Survey Bull. 427, pp. 162–163.

Camp Bessie Mine. (See Fable Manganese Mine.)

[1] U. S. Geol. Survey Bull. 427, 1910.

Davenport Prospect, is on the Winship Properties near the center of the north line of Section 27, T. 5 S., R. 4 E., one-half mile east of the Arroyo Mocho Road and twenty-five and one-half miles from Livermore.

Davenport and Smith Prospect, is on the Winship Properties in the NE¼ of Section 27, T. 5 S., R. 4 E., one-half mile from the Arroyo Mocho Road and twenty-five miles from Livermore.

Doak Mine No. 2, is in the Red Mountain district twenty-five miles southeast of Livermore on the Camp Bessie Road, in Sections 22–27, T. 5 S., R. 4 E., M. D. M.

Fable Manganese Mine, in SW¼ of NE¼ of Section 34, T. 5 S., R. 4 E., in a small canyon tributary to the Arroyo Mocho, about twenty-six miles southeast of Livermore.

Bibl: State Min. Bur. Bull. 38, p. 337; U. S. Geol. Survey Bull. 427, p. 162.

Keller Brothers had a slightly developed prospect of manganese in Section 13, T. 6 S., R. 4 E., in San Antone Valley.

Mammoth Prospect, is in Section 13, T. 6 S., R. 4 E., three-quarters of a mile east of a point which is thirty-two miles from Livermore on the Arroyo Mocho Road.

Mineral Products Company formerly owned two unnamed prospects one-half mile east of the Black Bird Prospect, near the east line of Section 28, T. 6 S., R. 5 E.

Mateos Ranch Deposit, is in Section 8, T. 6 S., R. 2 E., eight miles by road east of Milpitas, in Alum Rock Canyon, about two miles beyond the park. John D. Mateos, 165 North Fifteenth street, San Jose, owner.

Newhall Mine (Great Expectations Claim), is in Section 36, T. 5 S., R. 4 E., on the headwater of Colorado Creek, a branch of Black Bird Valley, twenty-nine miles southeast of Livermore.

Pennsylvania Manganese Mine, is in SE¼ of Section 12, T. 7 S., R. 4 E., thirty-five miles southeast of Livermore via the Arroyo Mocho Road.

Wallace Ranch, is in Section 8, T. 6 S., R. 2 E., six and one-half miles by road east of Milpitas.

Winship Properties. K. D. Winship, 350 Post street, San Francisco, owner. In the northeast corner of Santa Clara County, in the upper part of the Arroyo Mocho, these properties include the following sections containing manganese prospects. Section 27 and Section 35, T. 5 S., R. 4 E., M. D. M.

In the SW¼ Sec. 27, on the west side of the Red Mountain-Livermore road, at a point well above and easily accessible to the road is a series of manganese veins covering a width of about 50 feet. These croppings are traceable for a distance at least a couple of hundred yards long, running west of north. It could probably be followed much farther, but the chamise brush is very thick at this point. A little work was done some years ago around these outcroppings, and it is stated a few tons of high-grade ore hauled out. Material from there could be easily handled by a gravity tram to a loading point on the Arroyo Mocho road.

On the NE¼ of this same Sec. 27, is a good prospect of manganese ore. Some work was done a few years ago, said to have been by the same parties who worked on the SW¼. A short tunnel, now caved, is stated to have cut through a 4-ft. vein of high-grade ore. The surface indications are that it is at least that wide. The strike is west of north. There are other exposures on this same lead, to the south for about 200 or 300 feet. This deposit is on the east side of the Arroyo Mocho road in an ideal location for a gravity tram to handle the ore to bunkers.

MINERAL WATER

The numerous mineral springs of Santa Clara County are not confined to any particular locality or zone, but occur in the mountain ranges along both sides of the valley. They are all easily accessible and attractively located, and at the more important ones, recreation parks or health resorts have been established, while at others the waters are bottled for medicinal and table uses.

Most of the springs are carbonated and of small flow; a few are essentially sulphur springs, but the best known is a hot spring of large flow, Gilroy Hot Springs, which has been famous as a health resort for many years.

Dr. Winslow Anderson in his valuable book 'Mineral Springs and Health Resorts of California' calls attention to the medicinal value of several of the springs, comparing them favorably to the famous waters of Europe, and in writing of the California springs, in general, states that "all that is needed to make them as serviceable in the restoration and maintenance of health as their famous sister springs in the east and in Europe is their further development, their chemical analysis, and the scientific administration and application of their waters."

Alma Soda Spring. The San Jose Water Works own a small carbonated spring in Cavanaugh Gulch, about a mile from Alma Station. The water, containing principally magnesia, sulphur, soda and iron is bottled and distributed locally for table uses, by C. Wood, 1075 Luther street, San Jose.

Bibl: State Mineralogist's Report XVII, p. 197.

Alum Rock Park Springs. A group of mineral springs issue from the banks along the sides of Alum Rock Canyon, seven miles northeast of San Jose. The country rock here is thin bedded sandstone and shales highly tilted and folded. The springs are all of small flow and slightly sulphureted. They vary greatly in their chemical characteristics, as will be seen by referring to the analyses below, extracted from U. S. Geol. Survey Water Supply Paper No. 338. Most of the springs have been improved by cement basins to form drinking pools, and water from several of them is piped to the baths.

This property, owned by the city of San Jose, is conducted as a recreation park and is equipped with a natatorium, cafe, and numerous concessions. The Peninsular Railway operates an electric line to the park.

Bibl: State Mineralogist's Reports XII, p. 345; XIII, p. 518; XVII, p. 200. U. S. Geol. Survey Water Supply Paper No. 338, pp. 208–210. Mineral Springs and Health Resorts of California, Anderson, Winslow, pp. 78–80.

Analyses of Water from Alum Rock Park Springs, Santa Clara County, California

(Constituents are in parts per million)

	1		2		3		4		5		6		7		8	
Properties of reaction:																
Primary salinity	38		33		69		36		28		25		39		42	
Secondary salinity	0		0		14		0		0		0		0		0	
Tertiary salinity	0		0		0		0		0		0		0		0	
Primary alkalinity	48		49		0		53		60		39		28		33	
Secondary alkalinity	14		18		17		11		12		36		33		25	
Tertiary alkalinity	104		91		10		80		61		2		2		42	
Constituents	By weight	Reacting values	By weight	Reacting values	By weight	Reacting values	By weight	Reacting values	By weight	Reacting values	By weight	Reacting values	By weight	Reacting values	By weight	Reacting values
Sodium (Na)	1,320	57.40	879	38.22	1,751	76.16	2,110	91.77	1,652	71.80	583	25.35	657	28.50	856	37.24
Potassium (K)	25	.64	24	.61	45	1.16	77	1.96	25	.64	15	.39	13	.34	15	.38
Lithium (Li)	Trace	Trace	Trace	Trace	Trace	Trace	Trace	Trace	Trace	Trace	Trace	Trace	Trace	Trace	Trace	Trace
Ammonium (NH_4)									0	.00	0	.00	0	.00	0	.00
Calcium (Ca)	142	7.11	101	5.02	423	21.10	164	8.16	127	6.33	198	9.86	161	8.02	152	7.60
Magnesium (Mg)	24	2.14	39	3.18	160	13.19	39	3.18	37	3.05	58	4.78	73	6.02	63	5.21
Iron (Fe) / Aluminum (Al)	5.9	.21	3.5	.13	6.9	.25	4.2	.15	.6	.02	1.9	.07	30	7.06	5.4	.19
Manganese (Mn)									0	.00	0	.00	0	.00	0	.00
Sulphate (SO_4)	197	4.10	205	4.28	2,418	50.34	10	.21	18	.38	305	6.36	390	8.11	290	6.04
Nitrate (NO_3)									0	.00	0	.00	0	.00	0	.00
Chloride (Cl)	765	21.60	404	11.39	1,522	42.95	1,323	37.35	800	22.58	133	3.75	308	8.68	534	15.05
Bromide (Br)									0	.00	0	.00	0	.00	0	.00
Iodide (I)									Trace	Trace	Trace	Trace	Trace	Trace	Trace	Trace
Carbonate (CO_3)	1,236	41.20	934	31.12	546	18.21	1,995	66.50	689	22.96	908	30.27	785	26.18	880	29.34
Metaborate (BO_2)	Trace	Trace	Trace	Trace	Trace	Trace	Trace	Trace	Trace	Trace	0	.00	0	.00	Trace	Trace
Arsenate (AsO_4)									0	.00	0	.00	0	.00	0	.00
Phosphate (PO_4)	12	.39	10	.32	3.4	.11	32	1.01	Trace	Trace	0	.00	Trace	Trace	0	.00
Silica (SiO_2)	20	.66	22	.73	60	1.99	21	.70	31	1.03	26	.85	26	.87	25	.82
	3,746.9		2,621.5		6,935.3		5,775.2		3,379.6		2,227.9		2,443		2,820.4	
Carbon dioxide (CO_2)	1,483	67.41	838	38.09	192	8.73	1,835	83.41	1,093	49.66	16	.37	0	.00	447	20.34
Hydrogen sulphide (H_2S)	37	2.17	68	3.99					0	.00	10	.59	13	.77	13	.76

1. Blue Sulphur Spring. Analyst, William Irelan, Jr. Authority, advertising matter.
2. White Sulphur (Sulphur tunnel No. 1). Analyst, William Irelan, Jr. Authority, advertising matter.
3. Salt-Condiment Spring. Analyst, William Irelan, Jr. Authority, advertising matter.
4. Soda Spring. Analyst, William Irelan, Jr. Authority, advertising matter.
5. Soda Spring (on west side of creek, 100 yards north of baths). Analyst and authority, W. D. Forbes (1910). Possibly the same spring as that represented by the preceding analysis.
6. Sulphur Spring (75 yards northwest of tea garden). Analyst and authority, W. D. Forbes (1910).
7. Blackwater Spring (west of tea garden). Analyst and authority, W. D. Forbes (1910).
8. Southernmost of three springs at Blackwater Spring house. Analyst and authority, W. D. Forbes (1910).

Azule Mineral Spring [1] is situated in a ravine a mile northward across a divide from Congress Springs. It was first known as Mills Seltzer Spring, but the name was early changed to Azule, from the blue appearance of the mountains to the southwest. The water was formerly bottled for table use, but it has not been on the market since about 1890. The property has, however, been improved as a picnic resort.

The spring rises in a small concrete house, from a crevice in dark-colored sandstone. Water also issues beside the spring house, apparently from the same crevice as that within the house, and the combined flow of the two streams in perhaps a quarter of a gallon a minute. The water is strongly carbonated and also tastes slightly of hydrogen sulphide. A very small deposit of Epsom salt was noticed beside the spring, and the channel is iron stained for a few yards below it. There are small deposits of lime carbonate farther downstream.

Although the spring issues from sandstone, serpentine that appears to form a dike not much more than 10 yards thick is exposed on the slope immediately above it. This dike may determine the position of the spring at this point, and the considerable amount of magnesia in the water that is shown by the following analyses, tabulated with one from Congress Springs, is probably explained by the presence of the serpentine. The water may be classed as secondary alkaline and primary saline, but the unusually large content of magnesium is noteworthy.

Bibl: State Mineralogist's Reports XIII, p. 518; XVII, pp. 200, 201. Anderson, Winslow, op. cit.

Analyses of Water from Azule Mineral Spring and Congress Springs, Santa Clara County, California

(Constituents are in parts per million)

	1		2		3	
Temperature	16° C. (60° F.)				10° C. (50° F.)	
Properties of reaction:						
Primary salinity	39		42		43	
Secondary salinity						
Tertiary salinity						
Primary alkalinity	13		11		36	
Secondary alkalinity	48		47		21	
Tertiary alkalinity	140		136		42	
Constituents	By weight	Reacting values	By weight	Reacting values	By weight	Reacting values
Sodium (Na)	972	42.25	990	43.03	1,746	75.90
Potassium (K)	126	3.21	117	2.86	20	.51
Calcium (Ca)	69	3.44	62	3.08	181	9.05
Magnesium (Mg)	462	38.02	462	37.99	144	11.87
Iron (Fe)					115	4.10
Aluminum (Al)					41	4.52
Sulphate (SO_4)					378	7.87
Chloride (Cl)	1,212	34.17	1,280	36.10	1,201	33.89
Carbonate (CO_3)	1,582	52.75	1,526	50.86	1,790	59.67
Silica (SiO_2)	55	1.82			68	2.26
	4,478		4,437		5,684	
Carbon dioxide (CO_2)	2,632	119.64	2,606	118.46	756	34.36

1. Azule Mineral Spring. Analyst and authority, Winslow Anderson (1888).
2. Azule Mineral Spring (bottled water). Analyst, James Howden. Authority, U. S. Geological Survey, Bull. 32.
3. Upper Spring, Congress Springs. Analyst and authority, Winslow Anderson (1888).

[1] Waring, Gerald A., Springs of California, U. S. Geol. Survey Water Supply Paper 338, pp. 212-213.

Blodgett Magic Spring is located seven miles west of Gilroy in Bodfish Canyon.[1] "The water issues in a board-curbed and inclosed pool near camp grounds, at the base of the canyon side 25 yards east of the stream. It is not strongly mineralized, but tastes slightly saline and is mildly sulphureted and carbonated. * * * The analysis shows a primary and secondary alkaline water with notable tertiary alkalinity and primary salinity. In former years it was bottled and sold locally to a small extent. The water issues from soft white sandstone.

"A spring that is known as the Blodgett Mineral Spring, or Magnesia Spring, is situated on the hillside above a branch of Bodfish Creek and several miles north of Blodgett Magic Spring. It issues from serpentine and its water is piped from a small covered and rock-walled basin one mile eastward to a tank near a farmhouse. The following analysis of the water shows that besides containing a large proportion of magnesia, the water of the mineral spring is primary and secondary saline in character."

Bibl: State Mineralogist's Report XVII, pp. 201–202.

Analyses of Water from Blodgett Mineral Spring and Blodgett Magic Spring, Santa Clara County, California

(Analyst and authority, Winslow Anderson, 1889. Constituents are in parts per million)

	Mineral		Magic	
Properties of reaction:				
Primary salinity	45		28	
Secondary salinity	16		----------	
Tertiary salinity	----------		----------	
Primary alkalinity	----------		21	
Secondary alkalinity	39		51	
Tertiary alkalinity	57		50	
Constituents	By weight	Reacting values	By weight	Reacting values
Sodium (Na)	111	4.83	129	5.61
Potassium (K)	34	.88	4.7	.12
Calcium (Ca)	30	1.48	61	3.05
Magnesium (Mg)	68	5.62	37	3.03
Iron (Fe)	Trace	Trace	Trace	Trace
Aluminum (Al)	Trace	Trace	37	4.15
Sulphate (SO_4)	222	4.63	42	.88
Chloride (Cl)	112	3.15	85	2.40
Iodide (I)	Trace	Trace	----------	----------
Carbonate (CO_3)	151	5.03	256	8.53
Metaborate (BO_2)	Trace	Trace	Trace	Trace
Silica (SiO_2)	93	3.08	70	2.33
	821	----------	721.7	----------
Carbon dioxide (CO_2)	32	1.45	79	3.58
Hydrogen sulphide (H_2S)	48	2.81	Trace	Trace

Coes Spring. A carbonated spring rises in a creek bed on the east slope of Pine Mountain, 11 miles east of Madrone. It is not utilized commercially. An analysis of the water is given with that of Madrone Spring, following.

Bibl: State Mineralogist's Reports XIII, p. 518; XVII, p. 202.
U. S. Geol. Survey Water Supply Paper 338, pp. 214–215.

[1]Waring, G. A., op. cit. pp. 273-274.

Calaveras Mountain Springs. J. Daniels, owner. Leased by Calaveras Water Company, G. W. Fieger, 354 E. Santa Clara street, San Jose. Calaveras Springs are located at an elevation of about one thousand feet, nine miles north of San Jose, up the Calaveras road three miles. The water is bottled and distributed locally. Analysis of water as made by H. Kleinhaus is as follows:

(Authority, advertising matter)

Temperature at Spring	52°F.
Calcium Carbide	4 grs.
Iron Carbonate	½ gr.
Chloride Sodium	1 gr.
Carbonate Soda	2½ grs.
Traces Magnesium with Silica, Alumina combined	3 grs.
Total Solids per Gallon	11 grs.

Congress Springs, formerly known as the Pacific Congress Springs, are in Campbell Creek Canyon, at the base of the Santa Cruz Mountains, 12 miles southwest of San Jose. A group of three springs, two of which are carbonated, flow from the bank of the creek. It is used for a recreation park and owned by the Peninsular Railroad Company, who operate an electric line to the park.

Bibl: State Mineralogist's Reports XII, p. 345; XIII, p. 519; XVII, p. 202. U. S. Geol. Survey Water Supply Paper 338, p. 212. Anderson, Winslow, op. cit., pp. 213–214.

Analysis of Water from Gilroy Hot Springs, Santa Clara County, California

(Analyst and authority, Winslow Anderson, 1888. Constituents are in parts per million)

Temperature	43° C. (110° F.)
Properties of reaction:	
Primary salinity	60
Secondary salinity	31
Tertiary salinity	0
Primary alkalinity	0
Secondary alkalinity	9
Tertiary alkalinity	62

Constituents	By weight	Reacting values
Sodium (Na)	228	9.93
Potassium (K)	17	.42
Calcium (Ca)	66	3.30
Magnesium (Mg)	43	3.57
Iron (Fe)	2.1	.075
Sulphate (SO_4)	185	3.85
Chloride (Cl)	422	11.91
Iodide (I)	Trace	Trace
Carbonate (CO_3)	46	1.53
Arsenate (AsO_4)	Trace	Trace
Silica (SiO_2)	57	1.88
	1,066.1	
Carbon dioxide (CO_2)	114	5.16
Hydrogen sulphide (H_2S)	61	3.58

Gilroy Hot Spring is situated 13 miles northeast of Gilroy on a hillside above Coyote Creek at an elevation of 1240 feet. There is one large mineralized spring here, which flows from a bank in a small ravine at a temperature of 112° F. It is housed in a bottomless concrete tank, from which the water is piped to tub baths and plunges. The flow is approximately 15 gallons per minute. The water is said to be efficacious

in the alleviation of rheumatism, kidney, liver, stomach, skin and blood diseases. Besides its uses for bathing, it is used for drinking, and it was formerly carbonated and bottled at Gilroy. The health resort established at this property in 1865 is one of the best known in California. There are hotel and cottage accommodations for 150 guests, but it is open only part of the year.

Bibl: State Mineralogist's Reports XIII, p. 518; XVII, p. 202. Water Supply Paper 338, pp. 81–82. Anderson, Winslow, op. cit., pp. 156–158.

Grant Spring is situated in Alum Rock Canyon, 5 miles above the park. It is a slightly mineralized spring of small flow, whose waters contain principally sodium and magnesium carbonates.

Bibl.: U. S. Geological Survey Water Supply Paper 338, p. 212. State Mineralogist's Report XVII, p. 203.

Hillydale Sulphur Spring.[1] A small sulphur spring is situated on property known as Hillydale, about four and one-half miles south of the former reduction works of the New Almaden quicksilver mine, or 20 miles by road southward from San Jose. The spring is on the western bank of a stream, 200 yards from the house on the place, and yields about one-half gallon a minute of moderately sulphureted water. The following analysis indicates a primary-saline, secondary-alkaline water whose total mineral content is small.

The water is used locally for drinking and is considered useful medicinally.

The spring is situated at the base of a basaltic slope, in an area of sedimentary rocks that may belong to the Franciscan formation. The rock near the spring contains much calcite and is stained with metallic sulphides, from which the sulphide constituents of the water are possibly derived.

Bibl: State Mineralogist's Report XVII, p. 203.

Analysis of Water from Hillydale Sulphur Spring, Santa Clara, California

(Analyst, F. R. Green, 1904. Authority, owner of spring. Constituents are in parts per million)

Properties of reaction:	
Primary salinity	57
Secondary salinity	0
Tertiary salinity	0
Primary alkalinity	6
Secondary alkalinity	37
Tertiary alkalinity	6

Constituents	By weight	Reacting values
Sodium (Na)	95	4.12
Calcium (Ca)	32	1.60
Magnesium (Mg)	9.5	.78
Iron (Fe)	1.0	.04
Aluminum (Al)		
Sulphate (SO_4)	39	.81
Chloride (Cl)	104	2.93
Carbonate (CO_3)	83	2.76
Silica (SiO_2)	11	.37
Hydrogen sulphide (H_2S)	374.5 Present	Present

[1]U. S. Geol. Survey Water Supply Paper, 338, pp. 271-272.

Madrone Spring is situated 14 miles east of Madrone Station, and about five miles north of Gilroy Hot Springs, on a tributary of Coyote Creek. The spring issues at edge of creek, and the water, which is strongly carbonated, is caught in a cement basin. It was formerly hauled in barrels to San Jose and bottled, but is now used only for drinking purposes about the place. There are several other springs which are only slightly mineralized on the property.

Bibl: State Mineralogist's Reports XIII, pp. 518–519; XVII, p. 204. U. S. Geol. Survey Water Supply Paper 338, p. 214. Anderson, Winslow, op. cit., p. 191.

Analyses of Water from Madrone and Coes Springs, Santa Clara County, California

(Constituents are in parts per million)

	1		2	
Properties of reaction:				
Primary salinity		1		3
Secondary salinity				
Tertiary salinity				
Primary alkalinity		29		8
Secondary alkalinity		70		89
Tertiary alkalinity		12		18
Constituents	By weight	Reacting values	By weight	Reacting values
Sodium (Na)	217	9.45	56	2.45
Potassium (K)	7.5	.19		
Lithium (Li)	Trace	Trace		
Barium (Ba)	1.2	.02		
Strontium (Sr)	Trace	Trace		
Calcium (Ca)	380	18.94	90	4.47
Magnesium (Mg)	37	3.04	182	14.94
Iron (Fe)	4.7	.17	21	.74
Aluminum (Al)			Trace	Trace
Manganese (Mn)	.8	.03		
Sulphate (SO_4)			27	.57
Chloride (Cl)	14	.40	6.4	.18
Carbonate (CO_3)	940	31.34	649	21.63
Metaborate (BO_2)	Trace	Trace		
Phosphate (PO_4)	3.2	.10	7.0	.22
Silica (SiO_3)	108	3.60	97	3.21
	1,713.3		1,135.4	
Carbon dioxide (CO_3)	Present	Present	Present	Present

1. Madrone Spring. Analyst, G. E. Colby.
2. Coes Spring. Analyst, M. E. Jaffa.

Santa Clara County Park Spring, usually known as Soda Rock on Stevens Creek. This spring is located five miles west of Cupertino and is owned by Santa Clara County. This park is used as an outing or recreation park.

The Santa Teresa Springs are located on the east slope of the Santa Teresa Mountains overlooking the Santa Clara Valley, 3 miles south of Edenvale. The water, which is very slightly mineralized, issues from seams in a formation of hard gray sandstone, flowing over 20 gallons per minute. It is caught in a large concrete reservoir, from which the water is piped to the ranch house below. P. A. Bernal of Edenvale is the owner.

Bibl: State Mineralogist's Report XVII, p. 205.

Analysis of the Santa Teresa Spring Water

(Constituents are in grains per gallon; analyst, Dr. H. Kleinhans; authority, advertising matter)

Silica	5
Aluminum and Iron Oxide	1
Calcium Carbonate	8
Magnesium Carbonate	3
Magnesium Sulphate	2
Sodium Sulphate	4
Sodium Chloride	1
Total solids	24

There are several sulphur springs along Bodfish Creek, none of which are utilized commercially. One, larger than the rest, situated about 7 miles west of Gilroy, close to the road.

NATURAL GAS AND PETROLEUM

Natural gas and petroleum have been produced in the county at two localities, namely: in Moody's Gulch, south of Alma Station, and on the Sargent Ranch, near the southern boundary of the county. Following is an extract from Bulletin No. 89, 'Petroleum Resources of California,' by Lawrence Vander Leck, 1921, with reference to this area:

"The topographic features of Santa Clara County consist of the Santa Clara Valley running north and south through the center of the county, with the Santa Cruz Mountains bordering it on the west and the Diablo Range on the east.

"The southwestern portion of the county has been mapped by the U. S. Geol. Survey.[1]

"The formations of the Diablo Range within this area consist mainly of Franciscan beds. On the western edge of the range, east of San Jose and the Mission San Jose, there are outcrops of Cretaceous and Tertiary which may underly the Santa Clara Valley at this point. The valley proper is covered with recent alluvium. On the western edge of the valley, the Santa Clara formation (upper Pliocene) consisting of sands and gravels and clays, is found outcropping. Beneath the Santa Clara and forming the core of the Santa Cruz Mountains at this point are beds of the Franciscan formation. Along the western edge of the county which is practically parallel to the top of the western slope of the Santa Cruz Range, is a long, narrow belt of Tertiary running the entire length of the county. The northern portion of this belt is made up of Oligocene, Vaqueros and Monterey beds. South of Loma Prieta, it consists mainly of Monterey shale, which continues as far south as the Pajaro River, where it turns east, crosses the range and finally dips under the Pliocene beds of the Santa Clara Valley at Sargent.

"Oil indications within the county are limited to the following areas:

(1) Moody Gulch. (2) Los Gatos. (3) Sargent.

"(1) Moody Gulch is in a westerly branch of Los Gatos Creek about two miles south of Alma. The gulch may be entered from the main county road from Santa Cruz to Los Gatos. Fig. 1 shows the general structure of the region and the formations that outcrop. The oil probably formed in the diatomaceous shales of the Monterey and then by

[1]U. S. Geol. Survey. Santa Cruz folio 163. By J. C. Branner.

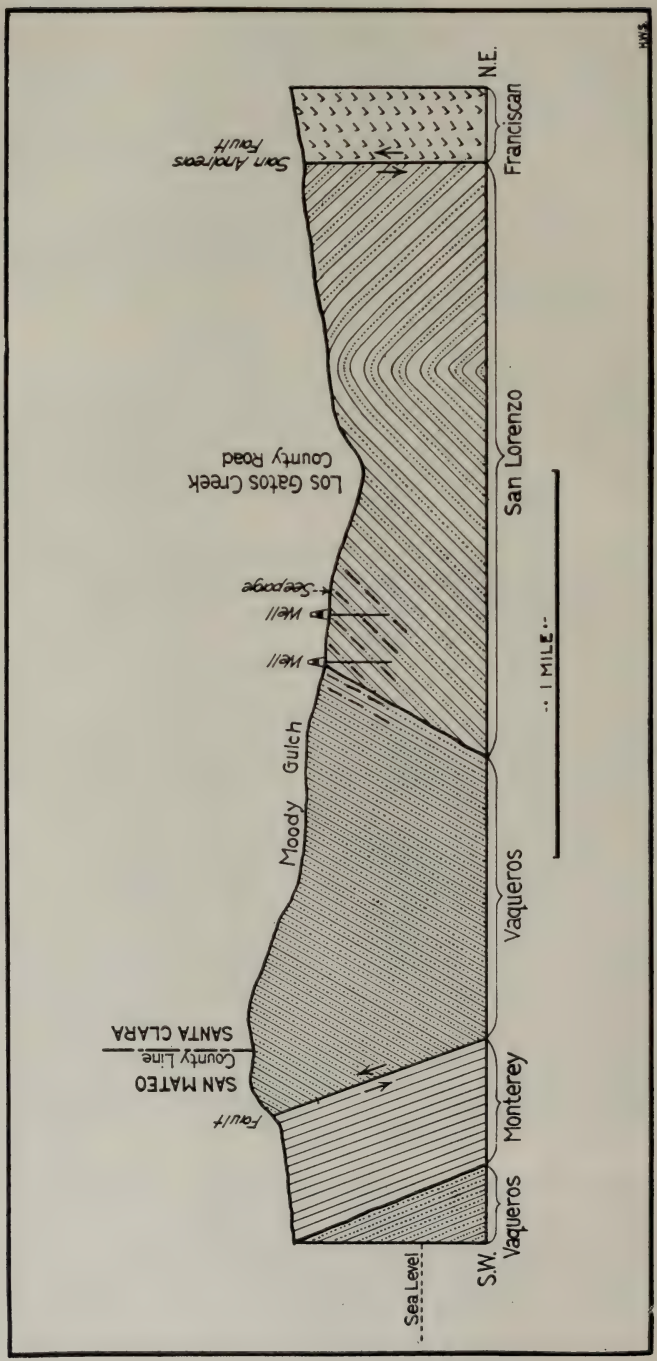


Fig. 1. Section up Moody Gulch, Santa Clara County.

reason of the fault contact has migrated into the porous sands of the Vaqueros and San Lorenzo formation. Drilling was first started here in 1880 and all together about 85,000 barrels of oil have been shipped from the gulch. The wells drilled number about 16, and the average depth is about 1200 feet. The gravity of the oil is 45° Baumé. The reported yield from the old wells varies from ten to forty barrels. Operations ceased about 1910, but recently the Trigonia Oil Co. has taken over the property containing the old Logan and Moody wells and is starting up operations again. The conditions that exist in the gulch probably extend for a mile or so both to the northwest and southeast. It is proable that with careful management the area around the gulch could be made to produce small wells of commercial value.

"(2) Los Gatos. Following is a report by C. A. Waring[1] of this region:

'The Santa Clara Valley region east of Los Gatos is covered with alluvial gravel, sand and soil so that the underlying formations are completely concealed. From wells drilled in the region it is evident that this land is underlain by rocks of the Monterey series which carry some oil.

'Drilling for oil has been carried on near the reservoir of the San Jose Water Company, on the San Jose road two miles northeast of Los Gatos. Oil indications were first noticed on the ranch of Mr. R. C. McPherson in an 85-foot well.

'Four wells have been drilled in the locality. At two of these the rigs are still standing but no operations are at present being carried on. In a 1600-foot well back of the barn on the property of Mrs. H. H. Main, gas may be seen bubbling through oil which fills the casing. Some oil is said to have been bailed from this well for use as fuel by the owners. A well on the south side of San Jose road is said to have been drilled 2530 feet deep, and to have pierced three oil strata.'

"In 1918 the Traders Oil Company drilled two wells, but failed to obtain a commercial production. Well No. 1 was drilled on the McGrath Ranch to a depth of 2000 feet and well No. 2 was located on the San Jose road near Walker avenue and reached a depth of 2675 feet.

"As stated above, it is probable that the region is underlaid by Monterey shale containing a little oil, but the presence of Franciscan rock on both sides of the valley restricts the shale to such a small area that production on a commercial scale is doubtful.

"(3) The Sargent Ranch field lies approximately in T. 11 S., R. 3 and 4 E., about three miles west of the railroad station of Sargent. The principal development has taken place along La Brea Creek. The formations outcropping are the Franciscan, Monterey sandstone and shale and Pliocene sands and clays. The oil originated in the diatomaceous shales of the Monterey and has collected in sandstone beds of the same formation. The Franciscan is found outcropping on the hills to the north of La Brea Creek and is overlaid by the Monterey formation which lies in the form of a crescent dipping at about 45° to the southeast. Westward the Monterey continues as far as a mile west of the Santa Clara-Santa Cruz County boundary, where it is truncated by the San Andreas fault. In its southward extension it is terminated by a fault along the Pajaro River. On the lower portion of La Brea Creek and in the hills just west of Sargent, the Monterey dips under the sandstones and shales of the Purisima. These later beds are dipping at an angle of 45° to the south. In the Lomas Muertas, south and east of Sargent, there are beds of sand and clay probably of upper Pliocene age. The axis of a small anticline runs southeast up the canyon just east of Sargent Station and finally flattens out into an east dip which is the general inclination of the strata in the Lomas Muertas.

[1]State Mining Bureau Bulletin 69, 1914, page 470.

There have been about twenty wells drilled along La Brea Creek. All obtained a showing of oil. Those which have produced on a commercial scale are located about two miles up the creek from the state hghway. The average depth is about 1500 feet and the oil is obtained from sandstone beds on a monocline in the Monterey. The gravity averages about 18° Baumé.

"At the present time (1921) the Watsonville Oil Company is operating nine wells with a total production of 75 barrels per day, which is apparently the maximum yield of the field. On Pescadero Creek and near Chittenden, a number of shallow wells were drilled obtaining small showings of heavy oil. Due to the fault contacts on the west and south and the serpentine contact on the north, there is no hope of extending the field in those directions. On the east the oil-bearing sand of the Monterey dips so steeply under the Pliocene beds, that the chance that they would be within reach of the drill is doubtful. On the axis of the anticline just east of Sargent in the Lomas Muertas (San Benito County) there is a possibility that these beds may be reached by drilling. The Shell Company is at the present time (1921) drilling a prospect well here."

The Watsonville Oil Co., A. W. Cox, Gilroy, president, is now operating nine wells, producing about 35 barrels per day, in the Sargent Ranch field. The *Continental Oil Co.* drilled three wells in 1927 and 1928, in Section 31, T. 11 S., R. 4 E., and Section 1, T. 12 S., R. 3 E., in the Sargent field, but failed to obtain any commercial production. The *Strader Oil Company, Ltd.,* is drilling a well on Section 8, T. 9 S., R. 1 W., M. D. M., in the Moody Gulch area.

From January 1, 1922, to December 31, 1928, the following notices of intention to drill in Santa Clara County were filed with the Division of Oil and Gas, in addition to the above:

Year	Company	Location Sec., T., R.	Well No.
1922	Douglas S. Watson	5–12–4	
1923	Santa Clara Oil Co.	1–12–3	1
1926	R. H. Shannon	8– 9–1 New Moody	4
1926	Alfred Tinally	7– 8–1	1
1927	W. H. Lingenfelter	8– 9–1	1
1928	H. W. Covert	8– 9–1	6
1928	Carl Crossen	9– 8–1	1

PYRITE

F. V. Gaffey, R. D. 1, Box 274, Watsonville, reports a large pyrite deposit near the highway in Santa Clara County. Undeveloped.

QUICKSILVER [1]

The first known occurrence of quicksilver within the area of the United States was that found at the New Almaden mine in Santa Clara County in 1824 by Antonio Sunol and Louis Chaboya. Though some occurrences had apparently been earlier noted in Mexico, the New Almaden was the first producing quicksilver mine in North America. Sunol and Chaboya built a mill nearby and endeavored to extract silver from the cinnabar. Late in 1845 the ore was shown to

[1]Bull. No. 78, California State Mining Bureau, 'Quicksilver Resources of California,' by W. W. Bradley.

Andreas Castillero,[1] a Mexican officer, who identified it as cinnabar, and under whose direction development work was immediately begun. Gun barrels were utilized as their first retorts. The output was small, however, until after California became part of the United States, since which time more than a million flasks have been produced in this county, the greater portion of which came from the New Almaden mine.

The quicksilver deposits of Santa Clara County are confined, with one exception, to what is known as the New Almaden District. This district lies east of south from San Jose, extending from the northeasterly foothills of the Gabilan Range on the west to the low foothills that lie between Coyote and Dry creeks on the east. It also embraces the Santa Teresa Hills, a low spur ridge which lies between and in general parallel to the other two. The principal deposits are 8 to 13 miles from San Jose, on the ridge which forms the southwestern boundary of the Santa Clara Valley at this place, having a general NW.-SE. direction, and locally called the New Almaden Ridge.

The geology of this district and particularly of the New Almaden Ridge and its ore bodies has been described in considerable detail by various writers, especially by Becker [2] and by Forstner,[3] the latter of whom says:

"The three ridges in which the deposits occur are to a great extent formed by serpentine, especially the two first named. The serpentine is associated with metamorphic sandstone and jaspilites. Large bodies of croppings can be found in each of these ridges, having also a general northwestern trend, but not coinciding with the backbone of the ridges.

"In the New Almaden ridge the most extensive orebodies have been found in and close to Mine Hill, the highest peak of the ridge, lying in its southeastern part. From this point going northwestward the croppings, while not continuous, can be traced along the ridge into the territory of the Guadalupe mine, a distance of about three and one-half miles. At the surface the serpentine shows in large detached bodies surrounded by the sandstones and shales of the Franciscan series and having a general northwestern trend. This general direction of the serpentine exposures is important in connection with its occurrence underground, proven in the New Almaden mine. The line of ore croppings runs from Mine Hill to the American shaft, passing about 600 feet southwest of the Randol shaft. The underground workings in this territory have shown that the fissures wherein the orebodies have formed have invariably a serpentine footwall; hence the serpentine must be considered to occur underground in a continuous body through this entire territory and to be in places covered by overlying sandstones and shales. Southwest of Capitancillos Creek lies another parallel exposure of serpentine, contiguous to which the outcrops of the Costello mines are found. The Santa Teresa and Bernal mines are located in the serpentine of the Santa Teresa hills, and the North Almaden or Silver Creek mine close to those of the most northern ridge. In the latter a great part of the serpentine is very highly altered by silification, as is also the sandstones, a great portion of the rocks being jaspilites. The western slope of the adjoining Mount Diablo range is nearly exclusively formed of shales.

"In this district the occurrence of cinnabar-carrying orebodies is clearly closely allied to that of serpentine, and as the New Almaden was the first extensively worked quicksilver mine in California, this association explains the reason why, for a considerable lapse of time, cinnabar ores were, in the opinion of most quicksilver miners, considered related to this rock formation. The croppings consist of a more or less weathered material having usually an ochreous color from the oxidation products of the iron sulphides, and traversed by a network of quartz seams, from a knife blade to quarter of an inch wide. Overlying the orebodies is almost invariably found a body of clay, generally black, and containing more or less inclusions of a dark-gray sandstone. As this clay overlies the ore bodies it has received the name of 'alta' (Spanish for 'high' or 'upper'). At the surface of this 'alta' crops is a light-gray material, resembling disintegrated sandstone, traversed by a network of very thin, yellowish-brown seams, often very much like a bunch of very fine roots. In places the same material can be found in the New Almaden mine several hundred feet below the surface, forming part of the 'alta.' * * * The rocks of the Franciscan series in this region show a great amount of silification. The chert beds are, however, almost entirely unrepresented.

[1] Black's Supreme Court Reporter: The United States vs. Andreas Castillero, vol. 2, 1862. Also U. S. Geol. Survey, Mon. XIII, pp. 8-10, 1888.

[2] Becker, G. F., Geology of the quicksilver deposits of the Pacific Slope; U. S. Geol. Survey, Mon. XIII, pp. 310-330, 467, 1888.

[3] Forstner, Wm., Quicksilver resources of California; Cal. State Min. Bur. Bull. 27, pp. 168-171, 1903.

"To the west of the New Almaden ridge a belt of bedded sandstone is exposed. The beds are from three to five feet thick and interbedded with thinner beds of shale. * * * The country west of the New Almaden ridge and south of Capitancillos Creek, belonging to the Gabilan mountain system, consists, almost exclusively of the sandstones and shales of the Franciscan series with occasionally some jaspilites. * * * West of the serpentine belt which lies west of the New Almaden ridge, south of Costello's house, a small exposure of glaucophane schist was found. A body of rhyolite lies in the northern part of the New Almaden ridge, having a nearly east and west strike and being about two miles long."

The Alta, or so-called clay referred to above, is not a substance of definite composition, though it is usually a dark or black mass, readily distinguishable even in hand specimens from the country rock. It is simply an attrition product of the country rock and varies in composition with the material from which it has been produced. Its black color is in part due to the presence of manganese.

With reference to the age of the formations in the New Almaden District, Becker [1] summarizes his observations in the following:

"Upon highly metamorphosed rocks lie Miocene sandstones, which were sharply folded at the Post-Miocene upheaval. They are not conformable with the lower series and contain pebbles from these older beds. In the older rocks near New Almaden Mr. Gabb found Aucella, proving the presence of the Knoxville series.

"In this district is the only mass of rhyolite thus far found in the Coast Ranges. It forms a dike nearly parallel to the line connecting the New Almaden and the Guadalupe. It is almost continuous, and I have followed it for a distance of several miles. It is certainly Post-Miocene and probably Post-Pliocene.

"The New Almaden is a very extensive mine * * * The ore is cinnabar, with occasional traces of native quicksilver, accompanied by pyrite and marcasite, with rare crystals of chalcopyrite. The gangue is quartz, calcite, dolomite, and magnesite. These materials were deposited in shattered masses of pseudodiabase, pseudodiorite, serpentine, and sandstone. * * *

"The other mines of the district contain similar ores in similar rocks. The Guadalupe was the most productive. * * *

"All the deposits of the district appear to occur along a rather simple fissure system. The main fissure is nearly parallel to the rhyolite dike at the Guadalupe. It follows the direction of the hills, the axis of which curves gradually away from the dike for a certain distance. Passing through or near the San Antonio and Enriquita, it seems to break across the ridge at the America and enters the Almaden on the strike of its two great fissures. It is near this fissure that new orebodies are most likely to be found. The Washington seems to be on a branch of the main fissure.

"This was probably formed at the time of the rhyolite eruption, to which also I ascribe the genesis of the ore."

Also: [2]

"This dike not only proves the former existence of volcanic activity in this district, but emphasizes a fundamental structural axis. The character of the metamorphic rocks shows that the line along which compression and upheaval took place in the early Cretaceous was about west by north, east by south. The folding of the Tertiary rocks shows that compression was repeated in the same direction at the close of the Miocene. The position of the rhyolite dike proves that the dislocation which opened a passage for this lava again followed a similar course."

Also: [3]

"Ore deposition followed the eruption of lava. The minerals deposited and the manner of their deposition are such as in the more northerly quicksilver districts were induced by volcanic springs. Though there are now no indubitable remnants of the volcanic activity which certainly prevailed here since the beginning of the Pliocene, the analogies of the deposit, together with the presence of lava of approximately the same age as the ore, make any theory of deposition excepting from hot sulphur springs improbable."

There have been but two mines of consequence developed in this district, the New Almaden and Guadalupe, though there are a number of

[1] Becker, G. F. Op. cit., p. 467.
[2] Becker, G. F. Op. cit., p. 314.
[3] Op. cit. p. 328.

small properties which have at times produced a few flasks of quicksilver.

Bernal Mine. Pedro A. Bernal, Edenvale, owner. It is 10 miles southeast of San Jose, on the east slope of the Santa Teresa hills, at an elevation of about 450 feet. A tunnel, over 200 ft. long, was driven along a clay gouge and serpentine contact, many years ago but failed to encounter any important orebody, so it was abandoned. No work has been done in recent years.

Bibl: Cal. State Min. Bur. Bull. 27, p. 171; Bull. 78, p. 157. State Mineralogist's Report XVII, p. 209.

California-Nevada Quicksilver Mining Co. Otto Taubert, president, 800 Carmel avenue, Berkeley. Incorporated under the laws of Nevada. This mine is located on the Tilton Ranch, 18 miles by road southeast of San Jose, below Coyote Station. Prospecting work has been done on the property by Taubert since September, 1929. Taubert reports a tunnel driven in about 160 ft., encountering a vein 18 inches wide, 60 ft. from the mouth, and another 10-ft. vein was struck 15 ft. further on, while the remaining distance penetrated was alta. Equipment includes air compressor, 20-h.p. Sampson gasoline engine, machine sharpener and drills.

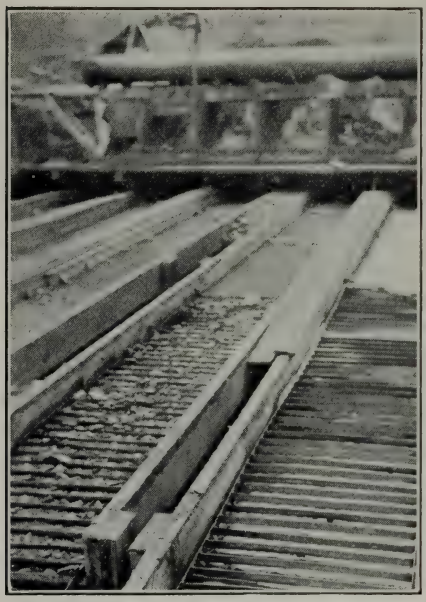
Guadalupe Mine. New Guadalupe Mining Co. J. S. Gregory, owner. Frank Golden, attorney, 582 Market street, San Francisco. This property, covering a territory of 2500 acres, is situated 10 miles south of San Jose on the west slope of New Almaden Ridge, and adjoins the land of the New Almaden Company on the northwest. The mine was discovered in the early 50's and is said to have produced 20,000 flasks of quicksilver up to 1875, when it became the property of the Guadalupe Mining Company. This company erected furnaces and made many surface improvements. In 1886 the mine was shut down due to litigation, remaining idle until 1900, when H. C. Davey organized the Century Mining Company. The old furnaces were remodeled, the mine unwatered, and operations resumed, since which time it was an important and continuous producer until recently. Idle.

The property has been described by so many writers that the reader should refer to the reports cited below for data on the geology, mine workings and past work.

Bibl: State Mineralogist's Reports VIII, p. 542; XIII, p. 600; XVII, p. 213. Bull. 27, p. 173; Bull. 78, pp. 157–160. Mineral Resources West of Rocky Mountains, 1875, p. 13; 1876, p. 20. U. S. Geol. Survey, Mon. XIII, p. 326.

New Almaden Mine (originally Chaboya; then Santa Clara). New Almaden Mines, Inc., owners. Mary L. Sexton, president; Knight, Boland and Christin, attorneys, Balfour Building, San Francisco. This property, covering over 8000 acres, lies from 8 to 13 miles east of south from San Jose along the New Almaden Ridge, and was at one time second only in production to the famous Almaden mine in Spain, after

which it was named. This property is the oldest known quicksilver mine in the United States, being first worked in 1824 by Antonio Sunol and Louis Chaboya. In 1845, Andreas Castillero, a Mexican army officer, 'denounced' (located) it under the name of Santa Clara. After the admission of California into the Union, Castillero and associates leased the mine to Barron, Forbes and Company, who changed the name to New Almaden.



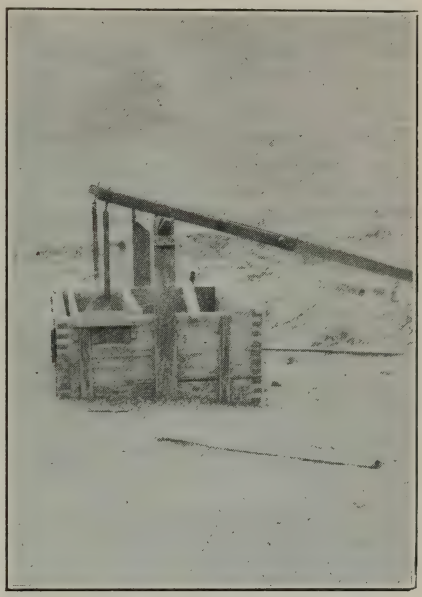
Sluices used to wash cinnabar ore at New Almaden Dumps, Santa Clara County.

The greatest surface improvements were made after it became the property of The Quicksilver Mining Company in 1864. Many important practices and appliances in the metallurgy of quicksilver had their beginning here, including the development of the Huttner-Scott fine-ore furnace in 1875–1876. The mine had been worked continuously from 1845 to 1926, but is now idle.

The property has been described by so many writers that the reader should refer to the reports cited below for data on the geology, mine workings and past work.

Retorts at New Almaden Dumps, showing heads with special "U" pipe fittings, Santa Clara County.

New Almaden Mine Dumps. E. T. Haun, Almaden, lessee. The old dumps from the furnaces, which cover approximately five acres, are being mined by the use of a power shovel. Dump trucks unload the ore down a wooden slide, where it is washed through a grizzly by water power, segregating the coarse ore. The ore is then washed down over a sluice. The sluice is arranged with heavy close-set wire riffles at the head, separating the finer ore first and the coarser later with wider-set wire grates. The ore that is washed over the riffles is collected and taken to the jig tank. The jig machine is operated by hand, separating the heavier from lighter material in the screen by agitation in water.



Jig tank, used to wash ore at New Almaden Dumps, Santa Clara County.

A 4-tube retort, erected by Haun in 1928, is used. A 70% recovery is claimed, as a special trap device is added on the tube heads. (See photo.) Three street L's are connected and the pipe screwed in each head at the bottom of the tube, so that the mercury flows up through the U-shaped pipe into the bucket below. Coal is used for fuel. When visited by the writer in January, 1930, the plant was idle as the property was in litigation.

Bibl: Note—The New Almaden mine and plant have been described by so many writers that only the principal references are here given. Others will be found in the Bibliography in Part III of Bulletin 78. State Mineralogist's Reports I, pp. 26, 27; IV, pp. 336 et al.; VIII, pp. 541–542; X, pp. 604–606; XI, pp. 374–375; XII, pp. 367–370; XIII, pp. 600–601; XVII, p. 224. Bull. 27, pp. 174–186; Bull. 78, pp. 160 et al. U. S. G. S. Mon. XIII, pp. 8, 310–330, 467. Min. Res. 1883–1915, inc. Mining Resources West of Rocky Mountains, 1867, pp. 170–178; 1874, pp. 33, 380, 540; 1875, p. 13; 1876, pp. 4–18, 20. Min. and Sci. Press, vol. 84, pp. 393–404, 1902; vol. 87, p. 201, 1903; vol. 100, pp. 15–16, 446–447; Feb. 16, 1916, pp. 282–284. Eng. and Min. Jour., vol. 34, pp. 185–186, 334, 1882; vol. 91, p. 85, 1911; vol. 102, p. 630, 1916. Geol. Surv. of Cal., Geol. vol. I, p. 68; vol. II, pp. 91–110, 122.

Santa Clara Quicksilver Corp. Formerly known as the Piercy property, just above the old Miller mine workings. Fred Murphy of San Jose in charge of operations. This property is located nine miles by road southeast of San Jose, just off the Forde road. This company started operations in November, 1928, securing the mineral rights from the Miller heirs. It is reported that 1400 ft. had been worked

in the old Miller tunnel, 300 ft. below the surface outcroppings, which is now partially caved in, as work was discontinued there in 1906.

Sandstone and jasper outcroppings are found on top of the ridge. A tunnel has been driven in near the surface outcroppings on top of the hill to about 100 ft. and a track has been laid. A jaw crusher, driven by a 2½-h.p. gasoline engine, crushes the ore. A 12-tube retort is in operation day and night, natural gas being used for fuel. Four men are employed.

Silver Creek Mine (North Almaden). A. R. Bradford et al., San Jose, owners. This property, formerly known as the North Almaden mine, is 12 miles by road southeast of San Jose, on the east side of Silver Creek. A large body of serpentine containing cinnabar was found in Silver Creek gulch, overlying Knoxville gravels. This detached body was evidently due to a great landslide which is plainly visible about the works. It was approximately 1000 ft. in length, 300 ft. wide, 60 ft. in thickness, and was exhausted in a few years, producing about $60,000 worth of quicksilver. It is reported that Mr. Slatore had been prospecting here last fall. The property is equipped with a 20-ton Scott furnace, partly demolished, and a pipe retort.

Bibl: State Mineralogist's Reports XII, p. 367; XIII, p. 600; XVII, p. 225. Bull. 27, pp. 187, 235, 238; Bull. 78, p. 168.

Numerous other quicksilver prospects now idle and owners unknown to the author are:

Bowie Prospect, New Almaden District.

Bibl: State Mineralogist's Report XVII, p. 209. Cal. State Min. Bur. Bull. 78, p. 157.

Brainard Prospect, situated south of the Guadalupe mine, and west of the northern end of the New Almaden lands.

Bibl: State Mineralogist's Report XVII, p. 209. Cal. State Min. Bur. Bull. 78, p. 157.

Comstock Mine, located in the extreme southeastern corner of Santa Clara County, in Sec. 19, T. 11 S., R. 7 E., M. D. M., and in the Stayton district, most of which lies in San Benito County.

Bibl: State Mineralogist's Report XII, p. 367 XVII, p. 210. Bull. 27, p. 172; Bull. 78, p. 157. Mineral Resources West of Rocky Mountains, 1875, p. 14.

Costello Mine is about one and one-half miles by road southeast of the Guadalupe mine, on the hillside above Los Capitancillos Creek at an elevation of about 1000 ft.

Bibl: State Mineralogist's Report XVII, p. 210. Cal. State Min. Bur. Bull. 27, p. 172; Bull. 78, p. 157.

Hillsdale or *San Juan Bautista Mine* (one time called Chapman; also Chaboya), is about 2 miles southeast of San Jose on the east slope of the San Juan Bautista Hills, and within one-half mile of a street car line.

Bibl: State Mineralogist's Reports XIII, p. 600; XVII, p. 213; Bull. 27, p. 174; Bull. 78, p. 160. Geol. Surv. of Cal. Geol., vol. 2, pp. 112–113.

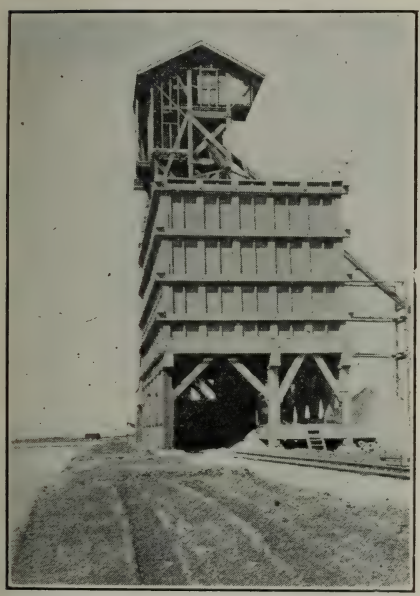
Santa Teresa Mine is eight miles southeast of San Jose on the east slope of the Santa Teresa hills.

Bibl: State Mineralogist's Report XVII, pp. 224–225; Bull. 27, p. 186; Bull. 78, pp. 167–168.

Wright Mine is three miles south of the New Almaden Hacienda, on Llagas Creek.

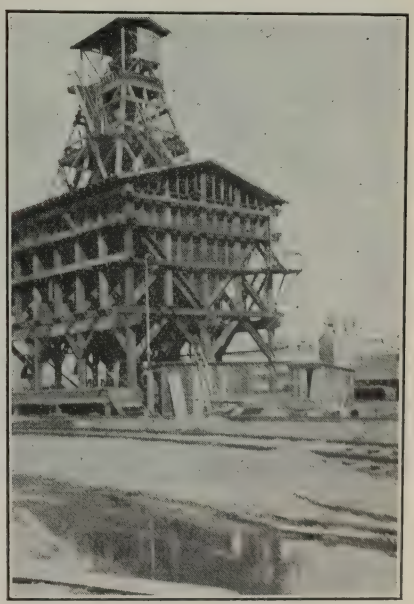
Bibl: State Mineralogist's Reports XII, p. 370; XIII, p. 600; XVII, p. 225; Bull. 27, p. 187.

SALT

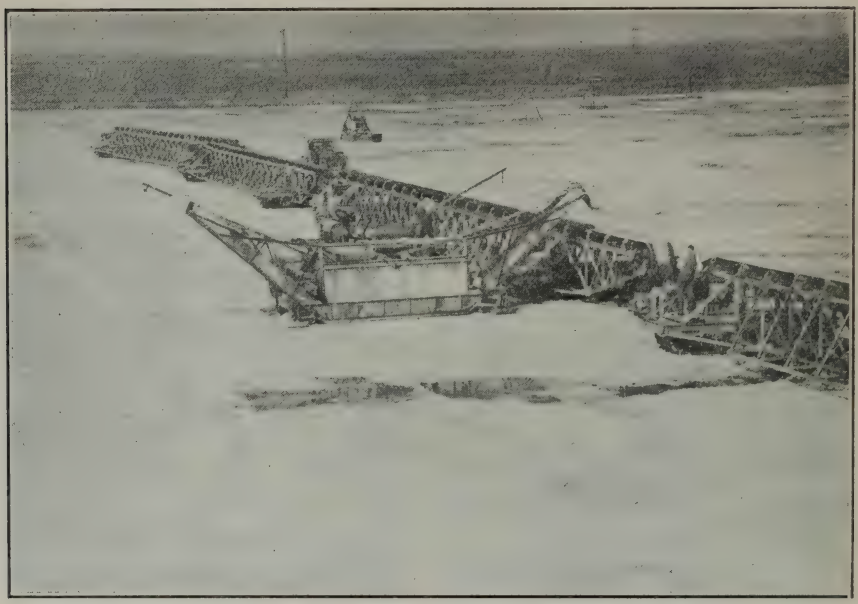


Washer at Alviso Salt Company's plant, Santa Clara County.

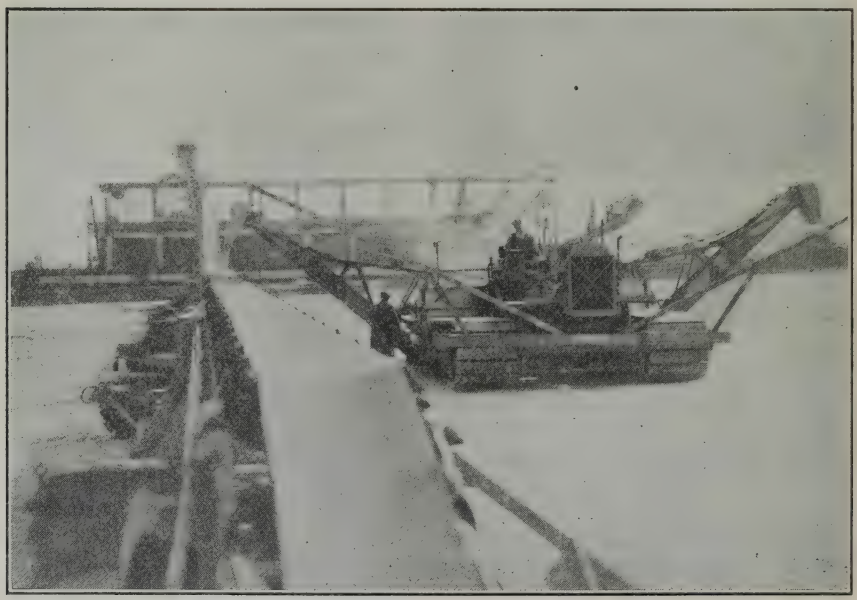
Alviso Salt Co.. V. S. Hardy, president; W. H. Makaffy, secretary. Home office, Russ Building, San Francisco. H. W. Bartlett, plant superintendent. The construction of this plant, at Alviso, began in 1923. The brine is pumped into a series of large outer ponds, 1000 ft. by 6000 ft., where it is concentrated by solar evaporation. The concentrated brine at the point of saturation is then thrown into the crystallizing ponds, where the evaporation is completed to dryness. Water is drained off the ponds once each year, usually between July and December. A harvester, run by a 60-h.p. Best tractor, scoops up the salt and conveys it onto a belt conveyor which loads it on a barge, that carries the salt up to the plant at Alviso. The conveyor belt is operated by one tractor, while each conveyor section is mounted on two caterpillars, operated by electric motor, so that the conveyors may be moved from pond to pond. The harvester first loosens the salt and then scoops it up, making a 16-ft. swath. Two men handle the entire harvesting operation. The plant at Alviso consists of a washer and a rewasher. Over 4000 acres are leased along the bay from Alviso to Mayfield. The potential capacity of the plant is about 225,000 tons per year.



Rewasher at Alviso Salt Company's plant, Santa Clara County.



Salt harvester loading salt on conveyor belt. Photo by courtesy of Alviso Salt Company, Santa Clara County.



Harvester, operated by a 60-h.p. Best tractor, placing salt on conveyor belts which load it on barge. Photo by courtesy of the Alviso Salt Company, Santa Clara County.

SANDSTONE

An extensive body of hard buff-colored sandstone, which is deposited in beds varying from a few inches to several feet in thickness, occurs at Graystone Station, 9 miles south of San Jose, on the Almaden branch of the Southern Pacific Railroad. This stone was formerly quarried for building purposes in San Francisco, San Jose and other towns, and it was used for the construction of the buildings of Stanford University. There has been no stone cut from this deposit for several years, and the only sandstone quarries now operated in the county are those producing crushed rock described under the heading, 'Stone Industry.'

Bibl: State Mineralogist's Reports VIII, p. 547; X, p. 618; XII, p. 399; XIII, p. 637; XVII, p. 225. Bull. 38, pp. 133–138.

STONE INDUSTRY (CRUSHED ROCK, SAND AND GRAVEL)

Anderson Quarry. G. H. Anderson of Mountain View has a rock quarry located three miles southwest of Los Altos. A dragline is used to work the material.

Bright Gravel Company. W. H. Bright and Earl W. Heple, owners. Office: 494 Delmas avenue, San Jose. Plant is located on Coyote Creek south of San Jose. The sand and gravel are mined by the use of a steam shovel and a dragline scraper. The material is fed into a hopper, then conveyed by belts to be crushed, screened and washed. Five men are employed.

California Concrete Products Co., formerly known as Merritt Concrete Products Co. Fred Holthouse, president; J. Demichelli, secretary. The plant is located at 1700 Monterey road, San Jose. All of the sand and gravel is purchased from Felton, Watsonville and from along Coyote Creek. After the sand and gravel are graded, they are mixed with water and cement by a paddle mixer and then the material is fed into a McCracken packer head pipe machine. The pipe is cured and placed in the yards to dry. Cement irrigation pipes and sewer pipes are the principal products. Electric power is used. About twelve men are employed.

Carroll Gravel Pit. W. A. Dunlap, owner. Operated by R. D. Carroll, 950 South Sixth street, San Jose. Plant is three miles south of San Jose on Coyote Creek. The deposit is worked by the use of team and fresno scraper. The sand and gravel is washed and screened.

Concrete Pressure Pipe and Construction Co., Inc. H. C. Scholten, president; L. Scholten, secretary. Plant at Gilroy, California. Sand and gravel is obtained from Logan, Olympia and Niles. Equipment includes screens, building-block machine and a pipe machine. Electric power is used. From five to twenty men are employed. Sewer and irrigation concrete pipe besides other concrete products are manufactured.

Kelley's Rock Quarry. A. M. Kelley quarries a serpentine rock used for road work, located north of Morgan Hill.

J. W. Lovejoy. This quarry is located about 4½ miles southwest of Mountain View, near the Los Altos Country Club's property. The

equipment consists of dragline, crusher, elevator, tractor and compressor.

Los Gatos Sand and Gravel Co. W. R. Burchell, Box 185, Los Gatos, owner. Pit located about 1½ miles north of Los Gatos, on Los Gatos Creek. Equipment includes Bearcat excavator, grizzlies, Allis-Chamber crushers, screens, 26-h.p. gasoline engine, etc. Three grades of crushed gravel are produced.

Martin Bros. Sand and Gravel Co. This plant, owned by M. P. Martin and B. C. Martin, Route 2, Box 205A, San Jose, was erected in 1927 and operations began in March, 1928. It is located on Coyote Creek, north of San Jose, on the Milpitas-San Jose highway. The gravel beds cover approximately twenty acres, with an overburden from

Associated Gravel Company's plant, Coyote, Santa Clara County.
Photo by courtesy of Pacific Coast Aggregates, Inc., owners.

a foot to six feet, which is sold for fill. The deposit is worked by the use of a dragline and a General excavator, equipped with an Erst clam-shell hoist, and hauled to the plant by trucks. The plant, equipped with link-belt machinery, crusher, trommels, elevators, washing vats, scalping screens, etc., has a daily capacity of 100 yards, and is operated by electric power. The water is pumped from their own well. Five men are employed. A clay, suitable as an oil-well drilling mud, has been used from this property.

Oar Quarry. Jim Oar, Mayfield, owner. Quarry located 4 miles south of Mayfield.

Pacific Coast Stone Co. Pratini and Cantu, Monterey road, San Jose, owners. Cast stone and cement are manufactured. Sand is obtained from the Olympia Sand and Gravel Co., Felton.

Pacific Coast Aggregates, Inc. Norman B. Livermore, president; C. C. Roller, secretary. Home office, Wells Fargo Building, Second and Mission Sts., San Francisco. This company recently took over the plants of the Associated Gravel Co., Bay Development Co., and Santa Clara Gravel Co.

Associated Gravel Plant. This plant, located 12 miles southeast of San Jose, on Coyote Creek, was constructed in 1927. There are over 400 acres of sand and gravel on this property along the former Coyote Creek bed. It is mined by a Bucyrus excavator and hauled to the plant on cars by a gasoline locomotive. This plant is equipped with link-belt machinery, gyratory crusher, trommels, elevators, washing vats, etc.; producing fourteen grades of sand, gravel and crushed rock. Electric power is used. Five men are employed. Mr. Bishop is plant superintendent.

Bay Development Plant. This plant adjoins that of the Associated Gravel Co. and is to be discontinued, as the new company can develop the remaining deposits from the Associated's plant.

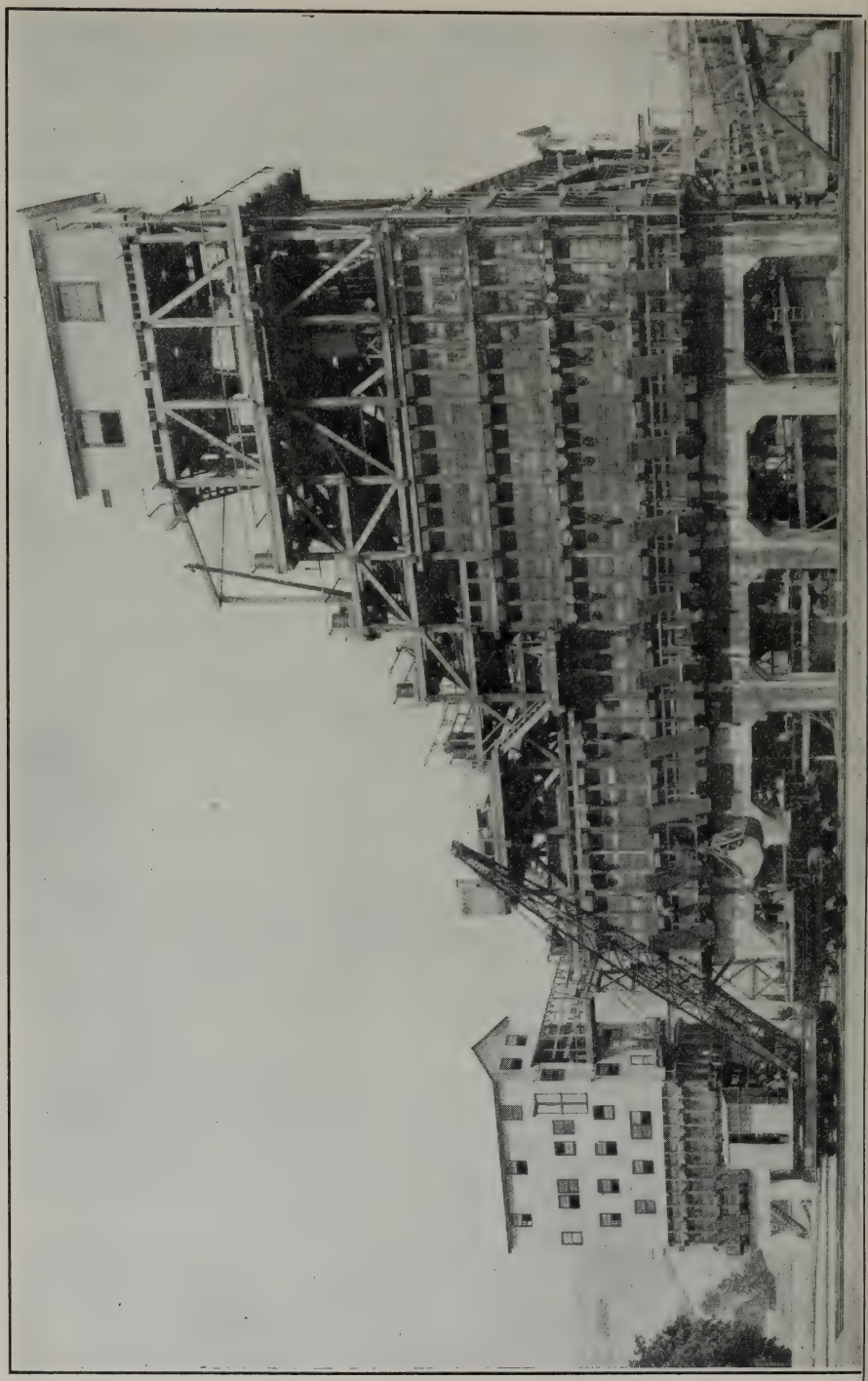
Santa Clara Gravel Plant. Located 1½ miles south of Campbell. R. Helstrom, Box 116, Campbell, foreman. This gravel bed along Los Gatos creek covers approximately 62 acres. A Link-Belt dragline excavator mines the beds. A gasoline locomotive and cars take the material to the plant, where it is scalped, crushed, washed and graded. Equipment includes a Bodinson screen and two Link-Belt screens. Electric power is used. Four men are employed.

Prentiss Paving Co., formerly known as Raymond H. Crummey, Inc. Chas. E. Prentiss, president; D. L. Morrison, secretary. The plant and office is located at Fifth and Keys streets, San Jose. About 10 acres of a gravel deposit are leased by this company 6 miles southeast of San Jose, opposite the Swickard Ranch, but are worked only 6 months during the year. Two draglines and two dry rotary screening machines are used. Three men are employed.

Raggio Cement Pipe Co. This plant is owned by George J. Raggio, and is located at 674 Stockton avenue, San Jose. The fine sand is obtained from Coyote Creek, while the remainder of the sand comes from Niles and Felton. Crushed rock is bought at Logan. The equipment consists of a Heer pipe machine and two mixers. The plant employs from 8 to 20 men, but operates only about 8 months during the year.

San Jose Concrete Pipe Co. This plant is located at 590 Stockton avenue, San Jose, and is owned by H. L. Ferguson and P. M. Matich. Sand is obtained from Olympia, Santa Cruz County, while some rock and gravel is secured from Coyote Creek. Among the equipment is a Heer pipe machine and two crushers. The plant is operated for about 9 months during the year, and employs about 9 men.

Santa Clara County Quarry, also known as Saratoga Rock Quarry, and formerly known as Stanfield and Knowles Quarry and Quality Sand and Rock Co. The county of Santa Clara is the owner of this quarry, situated 1 mile west of Saratoga, just below Congress Springs. The property is located in Section 11, T. 8 S., R. 2 W., M. D. M., and covers approximately 63 acres. The rock is a hard, gray, metapor-



phosed sandstone, which is mined with the use of a dragline and taken to the plant, which is equipped with 3 crushers. Electric power is used. Eight men are employed.

Bibl: State Mineralogist's Report XVII, pp. 226–227.

Santa Clara County Gravel Deposit. The county owns a small gravel deposit, 7 miles east of San Jose on the Mt. Hamilton road. This deposit is a cemented gravel and is shoveled on trucks by hand.

Stanford Quarry. Hutchinson Co., Inc. 1706 Broadway, Oakland, owners. N. F. Patterson, superintendent of the quarry. This quarry is located 1½ miles southwest of Mayfield on the Page-Mill road. The blue basalt rock is mined by means of a dragline. Plant equipment includes two Telsmith gyratory crushers (a No. 5 and No. 2), trommel, bucket elevators, etc. Electric power is used. Seven grades of crushed rock and three grades of base rock are produced.

J. H. Swickard, Route 4, Box 376, San Jose, has ornamental rock available for building purposes.

Taaffe Construction Co. Taaffe Bros., Los Altos, owners. Rock quarry located 3 miles west of Los Altos. Three men are usually employed the year round.

Thermotite Construction, Inc. F. O. Bohnett, president; L. D. Bohnett, secretary. Plant located at 580 Stockton avenue, San Jose. Concrete blocks used in building residences and commercial buildings are manufactured. Some sand and gravel is obtained from Coyote Creek, but the greater part is shipped in from Campbell and Felton. Pumice in its natural lump state is used. The pumice, sand and gravel are mixed with cement, semi-dry, and tamped with a patented Thermotite tamping unit. The concrete blocks are cured in moist air for ten days before being put on the market. Electric power is used. From five to 40 men are employed.

Union Paving Co. J. A. Dowling, president; R. W. Telfer, secretary. Office, Call Building San Francisco. This company uses sand and gravel obtained from the Granite Rock Company and the Pacific Coast Aggregates, Inc. A plant is located at Gilroy and Santa Clara.

Numerous other sand and gravel pits operated along Coyote Creek near San Jose are:

Beasworrick Gravel Pit, using team and fresno; W. A. Dunlap; A. G. John; Jas. A. Lemieux; M. Montoya Gravel Pit, using team and fresno; Ralph Richmond; Henry Sands, using dragline scraper, Fordson hoist and screens; and A. S. Cardozo.

LOS ANGELES FIELD DIVISION

W. B. Tucker, and R. J. Sampson, Mining Engineers

On account of unfinished field work there is no report from the Los Angeles Field Division in this issue.

OIL FIELD DEVELOPMENT OPERATIONS

R. D. Bush, State Oil and Gas Supervisor

From September 29, 1929, to and including December 28, 1929, the following new wells were reported as ready to drill:

Company	Sec.	Twp.	Range	Well No.	Field
FRESNO COUNTY:					
Superior Oil Co.	29	21	17	Huffman 1	Kettleman Hills
KERN COUNTY:					
The Ohio Oil Co.	30	28	21	33	Belridge
The Ohio Oil Co.	30	28	21	34	Belridge
Standard Oil Co.	24	29	27	Kern Co. Lease No. 5 3	Fruitvale
Western Gulf Oil Co.	22	29	27	10-KCL-B	Fruitvale
C. C. M. O. Co.	23	28	27	29	Kern River
C. C. M. O. Co.	23	28	27	30	Kern River
General Petroleum Corp.	14	28	27	Wetmore 11	Kern River
General Petroleum Corp.	14	28	27	Wetmore 14	Kern River
Pan American Petroleum Co.	22	28	27	6	Kern River
Pan American Petroleum Co.	22	28	27	11	Kern River
Pan American Petroleum Co.	22	28	27	19	Kern River
H. L. Whiston	30	30	22	Whiston M. M. 1	McKittrick
C. C. M. O. Co.	8	32	23	86	Midway
Hugh B. Evans, Inc.	35	32	23	27	Midway
Honolulu Consolidated Oil Co.	8	32	24	42	Midway
Honolulu Consolidated Oil Co.	8	32	24	74	Midway
Honolulu Consolidated Oil Co.	8	32	24	75	Midway
The Ohio Oil Co.	32	30	22	M. M. 1	Midway
Republic Petroleum Co.	7	32	23	36	Midway
Standard Oil Co.	1	32	23	125	Midway
Standard Oil Co.	1	32	23	260	Midway
Standard Oil Co.	5	32	24	16	Midway
A. Bruce Frame	28	26	28	Dominion 3	Mt. Poso
General Petroleum Corp.	21	27	28	Glide 21 16	Mt. Poso
Pacific Western Oil Co.	22	27	28	King 5	Mt. Poso
Pacific Western Oil Co.	22	27	28	Rench 6	Mt. Poso
Petroleum Securities Co.	15	27	28	Glide 1	Mr. Poso
Petroleum Securities Co.	21	27	28	Glide 18	Mt. Poso
Petroleum Securities Co.	21	27	28	Glide 19	Mt. Poso
Shell Oil Co.	15	27	28	Glide 2	Mt. Poso
Signal Oil and Gas Co.	27	27	28	SignalGlide 15-C	Mt. Poso
Signal Oil and Gas Co.	27	27	28	Signal Glide 24-B	Mt. Poso
Union Oil Co.	4	27	28	S. & M. 7	Mt. Poso
Union Oil Co.	28	27	28	Tribe 8	Mt. Poso
Union Oil Co.	28	27	28	Tribe 9	Mt. Poso
Vedder Brothers, Inc.	28	26	28	Johnson 1	Mt. Poso
Elbe Oil Land Development Co.	20	28	29	Freeman 5	Round Mountain
Shell Oil Co.	19	28	29	Jewett 3-2	Round Mountain
Shell Oil Co.	29	28	29	Jewett 9	Round Mountain
Shell Oil Co.	29	28	29	Jewett 10	Round Mountain
Barnsdall Oil Co.	17	11	23	Hazelton 1-A	Sunset
Barnsdall Oil Co.	17	11	23	Hazelton 2-A	Sunset
Doyle Petroleum Corp.	8	11	23	Berta Wier 3	Sunset
Doyle Petroleum Corp.	8	11	23	Berta Wier 4	Sunset
Doyle Petroleum Corp.	8	11	23	Son-Crail 2	Sunset
Hancock Oil Co.	8	11	23	Maricopa 3	Sunset
Hancock Oil Co.	8	11	23	Maricopa 4	Sunset
Lake View Oil & Refining Co.	4	11	23	12	Sunset
North American Oil Consolidated	8	11	23	Kerchkoff 2	Sunset
North American Oil Consolidated	8	11	23	Kerckhoff 4	Sunset
North American Oil Consolidated	8	11	23	Kerckhoff 5	Sunset
North American Oil Consolidated	8	11	23	Kerckhoff 6	Sunset
North American Oil Consolidated	8	11	23	Sunset 5	Sunset
North American Oil Consolidated	8	11	23	Sunset 7	Sunset
North American Oil Consolidated	8	11	23	Sunset 8	Sunset
North American Oil Consolidated	18	11	23	Lincoln 2	Sunset

OIL FIELD DEVELOPMENT OPERATIONS—Continued

Company	Sec.	Twp.	Range	Well No.	Field
KERN COUNTY—Continued.					
Reservoir Hill Gasoline Co.	17	11	23	Havenstrite 3	Sunset
Reservoir Hill Gasoline Co.	17	11	23	Havenstrite 4	Sunset
Standard Oil Co.	9	11	23	5	Sunset
Standard Oil Co.	9	11	23	9	Sunset
Standard Oil Co.	9	11	23	10	Sunset
Standard Oil Co.	9	11	23	11	Sunset
Standard Oil Co.	16	11	23	Bonynge 1	Sunset
Standard Oil Co.	16	11	23	Bonynge 2	Sunset
Standard Oil Co.	16	11	23	Bonynge 3	Sunset
J. Parker Thompson	7	11	23	Richardson 1	Sunset
Doyle Petroleum Corp.	14	27	18	1	----------
Evelyn Eubank	11	20	24	1	----------
Keystone Petroleum Corp.	18	28	22	1	----------
Willard Mallery	9	10	23	1	----------
Shell Oil Co.	32	32	23	Gonyer 1	----------
KINGS COUNTY:					
Associated Oil Co.	35	21	17	Whepley 1	Kettleman Hills
LOS ANGELES COUNTY:					
Standard Oil Co.	17	2	14	L. A. Investment 1 61	Inglewood
Carter Petroleum Co., Ltd.	24	4	13	1	Long Beach
Dabney-Johnston Oil Corp.	18	4	12	47	Long Beach
Dabney-Johnston Oil Corp.	29	4	12	48	Long Beach
Dabney-Johnston Oil Corp.	29	4	12	51	Long Beach
Dabney-Johnston Oil Corp.	29	4	12	52	Long Beach
Davis & Macmillan Co.	19	4	12	15	Long Beach
George F. Getty, Inc.	29	4	12	L. B. 28	Long Beach
Graham-Loftus Oil Corp.	24	4	13	3	Long Beach
A. T. Jergins Syn., Inc.	13	4	13	10	Long Beach
W. R. Jermain	30	4	12	1	Long Beach
A. H. MacFarland Syn.	13	4	13	MacFarland 1	Long Beach
W. F. Meyer	29	4	12	6	Long Beach
C. W. Murphy	24	4	13	Murphy 1	Long Beach
Pan California Oil Corp.	29	4	12	8	Long Beach
Plymouth Oil Co.	29	4	12	9	Long Beach
E. J. Preston	24	4	13	31	Long Beach
Rawco, Inc.	29	4	12	Coulter 1	Long Beach
Rawco, Inc.	29	4	12	Noll 1	Long Beach
Woolner Oil Corp.	13	4	13	L. B. Fee 2	Long Beach
Consolidated Oil Co.	8	3	16	1	Newhall
National Securities Oil Co.	1	3	16	Shepard 1	Newhall
Southern California Drilling Co.	13	3	16	Needham 2	Newhall
York-Smullin Oil Co.	13	3	16	1	Newhall
Associated Oil Co.	27	2	14	Prairie 1	Potrero
Associated Oil Co.	27	2	14	Prairie 2	Potrero
W. J. Barnhart	28	2	14	Potrero 1	Potrero
Thomas F. Barton	28	2	14	1	Potrero
Boardman-Blanchard	28	2	14	Boardman-Blanchard 1	Potrero
Globe Lease & Royalty Co.	28	2	14	6	Potrero
Globe Lease & Royalty Co.	28	2	14	7	Potrero
Hugh Grant	28	2	14	Grant-Inglewood 4	Potrero
J. G. F., Inc., Ltd.	28	2	14	1	Potrero
Richfield Oil Co.	28	2	14	Coffin 1	Potrero
Richfield Oil Co.	28	2	14	Hassen 1	Potrero
Sunset Pacific Oil Co.	28	2	14	Inglewood Comm. 2	Potrero
Sunset Pacific Oil Co.	28	2	14	Inglewood Comm. 3	Potrero
Wallace Taylor	28	2	14	3	Potrero
Ventura Pacific Petroleum Co.	28	2	14	2	Potrero
York-Smullin Oil Co.	28	2	14	Fee 2	Potrero
Barnsdall Oil Co.	18	3	13	Trust 1	Rosecrans
William Diller	8	3	13	1	Rosecrans
Hanners Oil Co.	17	3	13	Hanners 1	Rosecrans

OIL FIELD DEVELOPMENT OPERATIONS—Continued

Company	Sec.	Twp.	Range	Well No.	Field
LOS ANGELES COUNTY—Cont.					
Bell View Oil Syn.	6	3	11	Santa Fe 4	Santa Fe Springs
General Petroleum Corp.	5	3	11	Anderson 153-F	Santa Fe Springs
General Petroleum Corp.	5	3	11	Santa Fe 160-D	Santa Fe Springs
General Petroleum Corp.	5	3	11	Santa Fe 219	Santa Fe Springs
General Petroleum Corp.	5	3	11	Santa Fe 231	Santa Fe Springs
General Petroleum Corp.	5	3	11	Santa Fe 238	Santa Fe Springs
George F. Getty, Inc.	5	3	11	S. F. S. 46	Santa Fe Springs
George F. Getty, Inc.	6	3	11	S. F. S. 47	Santa Fe Springs
George F. Getty, Inc.	6	3	11	S. F. S. 48	Santa Fe Springs
Shell Oil Co.	31	2	11	Besser 1	Santa Fe Springs
Standard Oil Co.	31	2	11	Santa Gertrudes 14	Santa Fe Springs
Standard Oil Co.	6	3	11	Walker Comm.23	Santa Fe Springs
Standard Oil Co.	6	3	11	Walker Comm.24	Santa Fe Springs
Standard Oil Co.	6	3	11	Weisel 19	Santa Fe Springs
Union Oil Co.	31	2	11	Bell 56	Santa Fe Springs
Union Oil Co.	31	2	11	Bell 58	Santa Fe Springs
Union Oil Co.	31	2	11	Howard 14	Santa Fe Springs
Union Oil Co.	31	2	11	Howard 15	Santa Fe Springs
Union Oil Co.	31	2	11	Howard 16	Santa Fe Springs
Union Oil Co.	5	3	11	Farwell 18	Santa Fe Springs
Union Oil Co.	5	3	11	Farwell 19	Santa Fe Springs
Union Oil Co.	5	3	11	Farwell 20	Santa Fe Springs
Union Oil Co.	6	3	11	Alexander 22	Santa Fe Springs
Union Oil Co.	6	3	11	Alexander 23	Santa Fe Springs
Union Oil Co.	6	3	11	Alexander 24	Santa Fe Springs
Union Oil Co.	6	3	11	Bell 57	Santa Fe Springs
Union Oil Co.	6	3	11	Bell 59	Santa Fe Springs
Union Oil Co.	6	3	11	Bell 60	Santa Fe Springs
Universal Consolidated Oil Co.	5	3	11	O'Connell 7	Santa Fe Springs
Continental Oil Co.	34	4	12	Bryant 1	Seal Beach
Continental Oil Co.	3	5	12	McGrath & Selover 22	Seal Beach
Continental Oil Co.	3	5	12	McGrath & Selover 23	Seal Beach
Union Oil Co.	30	2	10	Sansinena 11	Whittier
Clearwater Oil Co., Ltd.	21	3	12	1	----------
Frank O. Creasey	21	3	13	Veach 1	----------
J. W. Martin	22	1	17	1	----------
Petroleo Syn.	33	4	12	2	----------
Raleigh Oil Co.	1	2	19	Malibou 1	----------
Western Gulf Oil Co.	28	2	9	1	----------
MADERA COUNTY:					
George F. Getty, Inc.	18	13	16	Gill 1	----------
MONTEREY COUNTY:					
Pacific Inland Oil Co.	19	23	15	1	----------
ORANGE COUNTY:					
Brea Canon Oil Co.	1	3	10	47	Brea-Olinda
Standard Oil Co.	21	3	10	Bastanchury Ranch 1	Coyote Hills
F. E. Bundy	11	6	11	Camp Ground 3	Huntington Beach
F. E. Bundy	11	6	11	Camp Ground 4	Huntington Beach
Rex Oil Co.	2	6	11	15	Huntington Beach
Richfield Oil Co.	2	6	11	Dieter-Golay 2	Huntington Beach
Standard Oil Co.	12	6	11	Thomson 11	Huntington Beach
West American Oil Co.	35	5	11	1	Huntington Beach
Continental Oil Co.	33	3	9	Mondotte 2	Richfield
Continental Oil Co.	33	3	9	Santa Fe 3	Richfield
Jimsco Oil Co.	33	3	9	Atwood 1	Richfield
Superior Oil Co.	32	3	9	Bennett 1	Richfield
Superior Oil Co.	33	3	9	Griffith 1	Richfield
Superior Oil Co.	6	4	9	Davis 1	Richfield
Shell Oil Co.	18	5	11	Alamitos Land & Water Co. 1	----------

OIL FIELD DEVELOPMENT OPERATIONS—Continued

Company	Sec.	Twp.	Range	Well No.	Field
SACRAMENTO COUNTY:					
Sacramento Petroleum Co.	28	7	8	Meiss 1	
SAN BERNARDINO COUNTY:					
Gerrard-Grimes Oil Co.	8	2	8	1	
John W. Sherman et al	33	2	8	1	
SAN DIEGO COUNTY:					
Borderland Exploration Co., Inc.	Pueblo Lot 211, City of San Diego			1	
SAN LUIS OBISPO COUNTY:					
A. T. Jergins Trust	6	32	13	Limited 7	Arroyo Grande
SAN MATEO COUNTY:					
Stratton Petroleum Corp.	16	6	5	1	
SANTA BARBARA COUNTY:					
Bankline Oil Co.	15	4	29	89-2	Elwood
Barnsdall Oil Co.	15	4	29	Luton-Bell 9	Elwood
Barnsdall Oil Co.	15	4	29	Luton-Bell 10	Elwood
Barnsdall Oil Co.	15	4	29	Luton-Bell 11	Elwood
Barnsdall Oil Co.	15	4	29	Luton-Bell 14	Elwood
Barnsdall Oil Co.	15	4	29	State Lease 88 2	Elwood
Barnsdall Oil Co.	23	4	29	Tideland Permit 95 1	Elwood
Barnsdall Oil Co.	23	4	29	Tideland Permit 96 1	Elwood
The Elmer Co., Ltd.	16	4	29	Eagle 1	Elwood
Elwood Exploration Co.	22	4	29	Elwood 2	Elwood
Pacific Western Oil Co.	16	4	29	Goleta Parcel 1	Elwood
Pacific Western Oil Co.	16	4	29	State Lease 92	Elwood
Signal Oil and Gas Co.	16	4	29	Signal Appleford 1	Elwood
Signal Oil and Gas Co.	16	4	29	Signal Dreyfus 1	Elwood
Standard Oil Co.	1	4	30	Standard Edwards 2	Goleta
Shell Oil Co.	31	9	33	Careaga A-1	Santa Maria
Aquarian Petroleum Corp.	22	4	26	2	Summerland
George F. Getty	21	4	26	State Lease No. 16, Getty 11	Summerland
George F. Getty, Inc.	22	4	26	Seaside Fee 1	Summerland
William D. Inskeep	16	4	26	Meyer 1	Summerland
Lincoln Drilling Co.	21	4	26	McDonald 1	Summerland
Benjamin F. Bailard	33	4	25	127-1	
Catherine Bailard	33	4	25	126-1	
Charles E. Bailard	34	4	25	129-1	
Kittie C. Bailard	33	4	25	124-1-A	
Myrtle Bailard	33	4	25	125-1	
Robert Bowles Oil Co.	22	4	28	Tideland Permit No. 140 1	
R. W. Caspers	32	4	25	State Permit 130 1-A	
Continental Oil Co.	33	4	25	124-1	
R. C. Foerster & C. C. Kreis	20	4	28	1	
Theresa Franklin	33	4	25	123-1	
General Petroleum Corp.	21	4	28	Bank 1	
General Petroleum Corp.	21	4	28	Crandall 1	
General Petroleum Corp.	21	4	28	James 1	
General Petroleum Corp.	21	4	28	More 2	
General Petroleum Corp.	21	4	28	Parker 1	
General Petroleum Corp.	21	4	28	Sands 1	
General Petroleum Corp.	5	4	30	Erburo 3	
Mary B. Hall	33	4	25	128-1	
D. A. Hargrave	27	4	27	1	
Callie M. Higgins	33	4	25	122-1	
Lucien M. Higgins	33	4	25	121-1	

OIL FIELD DEVELOPMENT OPERATIONS—Continued

Company	Sec.	Twp.	Range	Well No.	Field
SANTA BARBARA COUNTY—Cont.					
George A. McDonald	32	4	25	State Permit 120 1-A	
Oakburn Drilling Co.	4	4	30	168-1	
Oakburn Drilling Co.	5	4	30	169-1	
Oakburn Drilling Co.	5	4	30	170-1	
Oakburn Drilling Co.	5	4	30	171-1	
Oakburn Drilling Co.	5	4	30	172-1	
The Ohio Oil Co.	2	6	34	1	
Pacific Western Oil Co.	14	5	27	Gibraltar Dam 1	
Shell Oil Co.	18	4	25	Fithian 1	
Shell Oil Co.	5	4	30	Covarrubias 1	
Shell Oil Co.	1	4	31	Rutherford 2	
J. F. Shuman & W. T. Fitzgerald	20	4	28	1	
Standard Oil Co.	26	4	25	Shepard 1	
Standard Oil Co.	11	4	28	Santa Barbara County 1	
L. B. Tannehill	23	7	31	MacGillivray 1	
United States Petroleum Co.	20	4	28	1	
Wildcat Oil and Royalty Co., Ltd.	------	10	35	Donovan 1	
SANTA CLARA COUNTY:					
Strader Oil Co., Inc.	8	9	1	1	Moody Gulch
SOLANO COUNTY:					
A. T. Taecker	22	7	1	1	
TEHAMA COUNTY:					
Crockett Drilling Syn., Inc.	20	24	5	1	
Marker Drilling Co.	31	25	5	1	
TULARE COUNTY:					
Brittan-Terminal Oil Corp.	29	20	25	Gieck & Stephens 1	
Terra-Bella Oil Co.	35	22	27	Gardiner 1	
VENTURA COUNTY:					
Gilmore-Bishop Petroleum Corp.	18	4	22	1	Ojai
M. K. & T. Oil Co.	13	4	22	Sulphur Mt. 1	Ojai
E. A. Fennell Co., Inc.	13	4	19	1-F	Piru
George H. Hadley, Jr. Associates	13	4	19	11	Piru
C. C. M. O. Co.	8	3	24	Hobson B 10	Rincon
C. C. M. O. Co.	8	3	24	Hobson B 11	Rincon
General Petroleum Corp.	7	3	24	Ferguson 2	Rincon
Associated Oil Co.	23	3	23	V. L. & W. 9	Ventura
Associated Oil Co.	26	3	23	V. L. & W. 10	Ventura
Associated Oil Co.	26	3	23	V. L. & W. 14	Ventura
Bolsa Chica Oil Corp.	22	3	23	Barnard 1	Ventura
Shell Oil Co.	20	3	23	Taylor Lloyd 2	Ventura
Shell Oil Co.	28	3	23	Taylor 53	Ventura
Shell Oil Co.	28	3	23	Taylor 54	Ventura
Shell Oil Co.	29	3	23	Taylor 52	Ventura
Associated Oil Co.	19	4	24	Snowball 1	
Olympic Corp.	18	1	17	Calabasas 1	
Shell Oil Co.	6	1	22	Terry 1	
Shell Oil Co.	30	2	22	Leonard 1	

SPECIAL ARTICLES

Detailed technical reports on special subjects, the result of research work or extended field investigations, will continue to be issued as separate bulletins by the Bureau, as has been the custom in the past.

Shorter and less elaborate technical papers and articles by members of the staff and others are published in each number of 'Mining in California.'

These special articles cover a wide range of subjects both of historical and current interest; descriptions of new processes, or metallurgical and industrial plants, new mineral occurrences, and interesting geological formations, as well as articles intended to supply practical and timely information on the problems of the prospector and miner, such as the text of the new laws and official regulations and notices affecting the mineral industry.

BARITE IN CALIFORNIA*

By Walter W. Bradley, State Mineralogist

Production.

Barite, or barytes, as it is sometimes called, is one of the lesser groups of nonmetallic minerals comprising fifteen to twenty in number that are mined in California in varying amounts, ranging from a few hundred to less than a half million dollars in value annually.

Commercial production of this mineral in California, according to the records of the State Mining Bureau (now Division of Mines), began in the year 1910 with shipments totaling 860 tons, valued at $5,640 f.o.b. rail-shipping point. With the exception of the years 1924 and 1925, when no shipments were made, the output has varied, reaching a maximum of 26,796 tons, worth $168,829, in 1929. The 1928 output was 13,406 tons, worth $55,888 f. o. b. rail-shipping point, and the state total to the end of 1929 is 86,768 tons, valued at $482,759.

Before enumerating the Californian localities, it may be well, in order to round out the picture, to assemble, briefly, some of the data relative to the geology, also the preparation, uses and markets for barite and its products. Crude barite, sold or used by producers in the United States for the year 1927 amounted to 248,219 tons, valued at $1,594,423, according to the U. S. Bureau of Mines.[1] In addition, there was imported, principally from Germany, a total of 70,274 tons, valued at $253,284. Manufactured products from the above tonnages combined were distributed in 1927 (the latest year for which figures are at present available) as follows: ground barite, 57,658 tons; lithopone, 174,083 tons; barium chemicals (including: carbonate, 4960 tons; chloride, 3541 tons; binoxide and sulphate or 'blanc fixe' combined, 13,354 tons).

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*Presented in a somewhat briefer form by the author at the San Francisco meeting of the American Institute of Mining and Metallurgical Engineers, October 8, 1929. As published herein it becomes the first of a series of bulletins upon the Nonmetallic Industrial and Structural Minerals of California to be prepared by the staff of the Division of Mines during the ensuing biennium.

Acknowledgment is here made of contributions to these data on barite by Messrs. C. A. Logan, C. McK. Laizure, C. V. Averill, W. B. Tucker, and R. J. Sampson, district engineers of the Division, relative to properties in their districts.

[1]Mineral Res. of the U. S. in 1927, Part I, p. A18, 1929.

Missouri accounts for nearly 50 per cent of the domestic crude barite, followed by Georgia and Tennessee, with lesser amounts from Arizona, California, Nevada, South Carolina, and Virginia.

Occurrence.

Barite, also called 'heavy spar' and 'tiff,' is theoretically composed of 65.7 per cent of barium oxide (BaO) and 34.3 per cent of sulphur trioxide (SO_3) and has the chemical formula, $BaSO_4$. The specific gravity ranges from 4.3 to 4.6, and its hardness varies from 2.5 to 3.5. In the crystal form it is commonly found as an aggregate of straight or slightly curved cleavage plates, but it also occurs in granular, fibrous and earthy masses and in the form of stalactites. It is readily distinguished from calcite by its greater weight and the fact that it will not effervesce with acid. Most of the crude barytes mined in the United States [2] has some iron in the form of oxides as a coating on joints, faces of crystals, and surface of the lumps. Occasionally iron, lead, zinc, or copper sulphides are found in the barytes from some localities. Silica (both as quartz and chert), and calcite and fluorite are objectionable impurities present in some deposits. Commercial crude barytes should carry more than 93 per cent barium sulphate, and the better grades of domestic barytes carry at least 95 per cent $BaSO_4$; although in the case of lithopone manufacture, as noted under that subject, lower grade material can be ultilized without serious interference.

In the trade two types of barytes are recognized, 'hard crystalline' and 'soft.' The soft variety, as the name implies, can usually be crumbled, at least the edges of the crystals, by the fingers. The soft variety has a dull, milky-white color on fresh fractures, is preferred by grinders, and is said to roast better than the hard variety. The hard variety, however, can be made to roast well by a preliminary heating, and therefore can be used to better advantage in the lithopone and chemical industries than by grinders. Practically all of the Californian barytes thus far produced has been of the hard crystalline variety.

Barite occurs as a gangue mineral in many metalliferous deposits in the United States, but thus far apparently has but rarely been saved as a commercial product when treating the ores for their metal contents. One such utilization in the case of a Californian quicksilver ore is noted elsewhere herein. Some commercial deposits of barytes have the form of veins in sandstones, limestones, or crystalline rocks, and a few deposits of the replacement type have been worked. The greater part of the barite produced in the United States is mined from residual clays which are derived from the weathering of rocks that contained the minerals, namely: magnesian limestones (dolomite) of Cambrian and Ordovician age, pre-Cambrian crystalline rocks, and in a few places from Carboniferous rocks. Owing to the slight solubility of the barite and the silica, these minerals resisted the agencies of weathering and were left behind with the clay upon the removal of the soluble constituents of the original formations. There is little question that the original deposits were formed by precipitation from aqueous solutions. Some deposits, particularly those associated with metallic ores, were evidently derived from heated waters, but others were as evidently deposited from cold waters. The distribution of the barite in the

[2] Hill, J. M., Barytes and strontium, Min. Res. of the U. S., 1915, p. 164, U. S. Geol. Survey, 1916.

original rocks seems to have been influenced largely by the presence of openings through which the barium-carrying solutions could penetrate. In California none of the barite deposits thus far developed are of the residual type.

Uses.

The most important use of barite is in the manufacture of lithopone which forms the principal constituent of 'flat' wall paints. As shown by the production data given in a preceding paragraph, more than two-thirds of the 1927 (U. S.) tonnage of barium products was lithopone. Mixed with coke, the barium sulphate is reduced by calcination to the sulphide, which is alkaline and soluble in water. Iron and other impurities are removed by precipitation and filtration. Zinc is prepared in a sulphuric acid solution and introduced into the barium sulphide solution, resulting in a double precipitate, an intimate mechanical mixture of $BaSO_4$ and ZnS, both of which are white. The precipitate is then filtered, ground, and dried.

Mineral 'fillers,' as the term is used, are those nonmetallic minerals that, after being pulverized, are used in the preparation of various manufactured articles. Barite occupies an important position in the list. Although fillers are used in a great number of industries, the bulk of the material goes into the following products:[3] paper, wallpaper, prepared roofings, rubber, paint, linoleum, oilcloth, foundry facing, plastic cements, oxychloride cement, artificial stone, polishes and scouring compounds, matches, dressing and dusting powders, various textile products such as window-shade cloth, and phonograph records. Of the above, barite is utilized in important amounts in paint, paper, linoleum, oilcloth, and rubber, as well as in the preparation of a number of barium chemicals. The most important of such chemicals, other than lithopone, are: barium binoxide (used in preparation of hydrogen peroxide); barium carbonate (used by pressed brick and by rubber manufacturers to neutralize the sulphur content); barium chloride (used in battery plates, and as a mordant by dry-color manufacturers, and in tanning leather); barium nitrate (used in munitions and in making 'red-fire' material); barium sulphate precipitated, or 'blanc fixe' (used in rubber manufacture; for painting on interior steel of battleships and other sea-going vessels; also as a detector in taking X-ray pictures of the human body). Most crude barite having at least some iron stains or other impurities, has to be washed and acid-treated to remove them before being suitable for use as paint.

No standard specifications nor tests for either crude or ground barytes are in use.[4] Ground barytes is marketed in several grades dependent on color and fineness, from the coarse-grained, off-color product to the very fine-grained, pure-white, water-floated product. When used as a filler for paper or rubber, it must be at least 200-mesh and is often 350-mesh; the finer the better. For the paint trade a pure-white product is needed, but extreme fineness is not always desired; in fact, extremely fine-ground barytes is said to be unsuitable for some paint purposes. For the manufacture of lithopone and barium chemicals, soft, bleached barytes has been preferred in the past,

[3] Weigel, W. M., size and character of grains of nonmetallic mineral fillers, U. S. Bur. of Mines, Tech. Pap. 296, p. 1, 1924.
[4] Ladoo, R. B., nonmetallic minerals, p. 76, 1925.

but now the hard, crystalline, iron-stained product is used exclusively. A low silica and a low iron-oxide content are desired and maximum permissible amounts of these impurities are usually specified in contracts.

Ground barite is used chiefly as an inert mineral filler in paper, rubber, cloth, linoleum, oilcloth, etc., and as a paint material, both as a white pigment and as an inert extender. It is especially useful as a filler and a surfacing material where a highly calendered surface is desired, such as on playing cards and enameled paper. It is also utilized in artificial ivory and buttons; as a base for the precipitation of lake colors, in ceramic glazes and enamels; as a constituent of some types of glass, and as an inert filler and body material for many miscellaneous products where a heavy, crystalline filler is desired. One of the newest of these uses because of high specific gravity is the employment of barite in oil-well drilling mud.

[5]"While drilling through caving formations or a high pressure gas zone, great care is required to prevent the freezing of the drill pipe and avoid blow-outs with the possible wrecking of the well, and the successful landing and cementing of the casing is dependent on the proper control of these hazards. This control both in rotary and cable tool drilled wells is secured by the column of fluid, usually mud, maintained in the hole. In fields presenting these problems the weight of the column of ordinary rotary mud sometimes is not sufficient to preserve the walls or hold down the gas and it has been found necessary to increase the specific gravity of the mud by the addition of certain heavy minerals."

Barite so used is ground so that 98% will pass a 200 to 300-mesh screen.

"The average weight of the rotary mud used in the wells varies from 10 to 11½ pounds per gallon, or from 75 to 86½ pounds per cubic foot. Occasionally mud as heavy as 12¾ pounds per gallon or 92 pounds per cubic foot is used without the addition of heavy minerals. This is about the maximum weight of ordinary mud that the pumps will handle. By the addition of the heavy minerals and without increasing the viscosity the ordinary mud can be increased to as much as 13⅜ pounds per gallon, or 101 pounds per cubic foot. During ordinary drilling only the regular rotary mud is used, the weight as noted above ranging from about 75 to 86 pounds per cubic foot. The weight to be used depends on the amount of gas present in the hole, and character of formation being drilled. The lightest mud is used in shale formation and when the hole is comparatively free from gas, while heavier mud is used in sandy formation and when gas is present."

The composition of lithopone is approximately 70% barium sulphate and 30% zinc sulphide, though the sulphide is often in part replaced by 1% to 3% of zinc oxide. The commercial product is a very fine-grained white powder, 98% to 99% of which will pass a 300-mesh screen. Besides its use as a paint pigment it has a large use in the manufacture of high-grade rubber goods, such as automobile tires, rubber matting, fruit-jar rings, tubing, etc. In rubber it not only acts as a filler, but is valuable for the curative effect which the zinc sulphide has on the rubber. The records of the State Mining Bureau indicate that the first commercial preparation of lithopone in California began in 1920.

Barium chemicals may be made from either barite or witherite (barium carbonate), but in the United States barite is the chief raw material, though witherite is extensively used in Europe because of more abundant occurrences. The only deposit of the natural carbonate thus far utilized commercially in the United States is that at El Portal in Mariposa County, California, on the Merced River near the Yosemite Valley. Blanc fixe, or the precipitated barium sulphate is considered the best grade of the sulphate for pigment purposes, both in whiteness

[5]Thoms, C. C., use of heavy minerals in rotary drilling mud in the Ventura field, 12th Ann. Rept. of State Oil and Gas Super., Cal. State Min. Bur., Sept., 1926, p. 5

and in fineness of product. In chemical composition, it is practically identical with the natural-ground barytes, but its physical properties are different, for which reason it is preferred for some specific uses. Barium carbonate is a white, insoluble barium salt prepared by precipitation from a solution of barium sulphide with soda ash. Its largest use is in the ceramics industry for the manufacture of optical glass, for which purpose a chemically pure product is required. Recently, barium carbonate has assumed importance in the manufacture of flat wall paints, and this is expected to increase. When containing about 45% of precipitated barium carbonate, these paints product a velvety finish. Witherite (the natural carbonate) can not be used for this purpose and should not be confused with the precipitated carbonate.

The newest use for barium is in beet-sugar manufacture. [6]After several years' experimentation a successful process has been developed by the Great Western Sugar Refining Company at Johnstown, Colorado, using the hydroxide of barium instead of that of strontium which is so largely used in Europe. Nearly all of the beet-sugar plants in the United States use calcium hydroxide (lime), which is more readily obtainable and cheaper, though not as efficient. In the Great Western's procedure, barium carbonate is converted to barium oxide in the presence of barium silicate at furnace temperature. The clinker is ground and pulped in water, and the resultant liquor is cooled for the production of barium hydroxide crystals. A closed circuit process results in a minimum loss of barium. A saccharate is formed by the union of the salt with the uncrystallizable sugar in the molasses. This is decomposed by carbon dioxide, liberating the sugar.

CALIFORNIAN OCCURRENCES* AND PLANTS

Besides deposits described in the following paragraphs, barite is a common gangue mineral in vein deposits in California, especially with galena and therefore prominent in the silver-lead districts.

Alameda County.

There are no deposits of barite in this county, but for some years through a succession of owners there has been a plant at Melrose in the southern limits of Oakland engaged in the preparation of barium compounds. Originally built by the Barbour Chemical Company about 1912, it treated barite and witherite from the deposit at El Portal in Mariposa County. Later it was operated by Lewis, Gilman and Moore, who began the manufacture of lithopone in 1920. The plant is now owned and operated by the *Chemical and Pigments Company, Inc.*, principally in the preparation of lithopone with a capacity up to 25 tons per day. Some acid-treated, ground barite is also prepared.

The company owns the Democrat Mine in Nevada County, which is at present its principal source of barite. The mineral from the Democrat carries 88%–90% $BaSO_4$, and is in part almost black due to

[6]Eng. and Min. Journal, Vol. 128, p. 201, Aug. 10, 1929.

*Bibl. In addition to references given elsewhere herein: Cal. State Min. Bur. annual statistical bulletins of mineral production, 1912–1929; Bull. 38, pp. 264, 360; State Mineralogist's Reports IV, p. 78; VI, Pt. I, p. 94; VIII, pp. 509, 511; XII, p. 406; XIV, pp. 204, 571, 761; XV, pp. 480, 624, 734, 853; XVII, pp. 156, 317, 334, 434; XVIII, pp. 43, 115, 214; XIX, pp. 7, 20; XX, pp. 12, 16; XXI, pp. 28, 164, 300, 545; XXII, pp. 129, 512; XXIII, p. 138; XXIV, p. 144. Nevada County, 1918, p. 71. Plumas County, 1918, p. 36.

carbonaceous matter, but this is an advantage rather than a detriment, as the ore is first mixed with 25% of petroleum coke. It is then crushed to $\frac{1}{4}$ inch, dried, and calcined to BaS, in which reduction the carbon assists. The sulphide is dissolved in water, then the iron and other impurities are precipitated out and filtered off. The zinc used is 'zinc dross' from Anaconda, Montana, carrying 88% Zn and some oxide with cadmium, iron and other impurities. These are dissolved in sulphuric acid, and the impurities likewise removed by precipitation and filtration.

The zinc sulphate solution is run into the tank containing the barium sulphide solution and the mixed $BaSO_4$ and ZnS precipitate (lithopone) results. This filtered becomes the 'green cake' which is dried at from 500° to 700° C., according to the degree of oil absorption quality desired in the final product. This dried cake is then ground wet and dried in a special drier on a traveling screen, following which it is ground in a Raymond mill to 320 mesh and sacked in paper bags. A fractional percentage of Prussian blue is added to improve the whiteness.

Humboldt County.

On *Liscom Hill*, eight miles northeast of Arcata, a number of veins of white, crystalline barite have been noted, showing from a few inches to a foot in width and standing nearly vertical. Boulders of barite nearby indicate that development work might uncover a workable deposit of the mineral.

Inyo County.

Massive barite is recorded [7] as occurring in several localities in this county, and in veins in the Alabama Hills. Shipments were made during the World War period from a deposit near Laws. At present, Joseph Smith, Laws, owns two claims in Gunter Canyon on the west flank of the White Mountains, six miles northeast of Laws on the California and Nevada Railroad. A series of parallel veins of barite 2 to 8 feet in width occur in Cambrian schists and slates, and trend N. 30° W., with dip 60° E. The barite is white, reported to carry 94% $BaSO_4$, and a considerable tonnage is exposed on each side of the canyon.[8]

R. A. Fredericks, 619 Seventeenth street, Merced, has acquired a large deposit near the Inyo-Tulare County line and expects to be in a position to ship barytes by early summer 1930.

Lake County.

In the Museum collection of this division there is a specimen of barite stated to have come from an undeveloped deposit near Glenbrook.

Los Angeles County.

A deposit of white barite said to carry 85%–87% $BaSO_4$ occurs on the west side of San Dimas Canyon, 8 miles northwest of San Dimas. The width ranges from 6 to 8 feet, and the outcrop is visible for a length of 50 feet. There are also several small lenses on the ridge above. Some material was shipped from here several years ago, but the property is not at present worked.

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[7] Eakle, A. S., Minerals of California, Cal. State Min. Bur. Bull. 91, p. 262, 1923.
[8] Tucker, W. B., Mineral resources of Inyo County, Report XXII of State Mineralogist, p. 513, 1926.

Mariposa County.

National Pigments Co., Inc. The barite deposit on the north side of the Merced River, a mile west of El Portal, was the first, and for several years the only, barite mined commercially in California. It likewise has the distinction of being the only deposit in the United States from which commercial shipments of the carbonate, witherite, have been made. The property, recently purchased by the National Pigments Co., Inc., was owned by the Yosemite Barium Company, and was formerly worked at different periods by El Portal Mining Company, the Barbour Chemical Company, and Western Rock Products Company.

The river canyon cuts directly across the barite lode, as do also the Yosemite Valley Railroad and the new Yosemite state highway, the last named being on the south side of the river. In March, 1927,

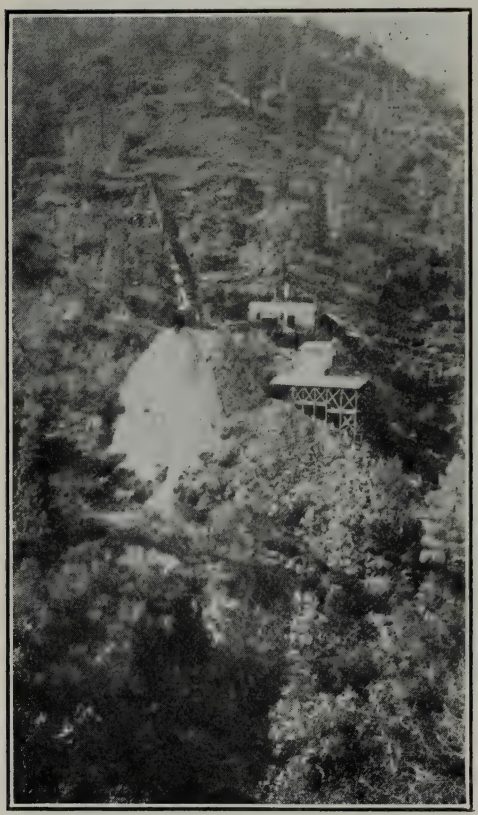
Barite plant of National Pigments Company near El Portal, Mariposa County, on north side of Merced River. Photo by R. L. Mook.

development of the veins south of the river was begun and the present output is now coming from these new workings, which comprise one or more open-cut faces and two adit levels at 80 feet and 260 feet, respectively, below the surface. The barite is mined by mill-hole and by drifting and stoping. The vein width varies, showing a series of lenses, averaging 14 feet, with a maximum of 35 feet. One of these lenses is estimated[9] to contain several hundred thousand tons of barite, averaging 94% $BaSO_4$. The wall-rock is a graphitic quartzite-schist. The barite is a fine-crystalline, massive mineral showing stratified or banded deposition. It is light-gray to white in color. The company's holdings cover 500 acres. An aerial tramway carries the ore across the river to the plant on the railroad.

Preliminary coarse crushing is done at the tramway loading terminal at the mine. The mill recently built, with a present capacity of 60

[9]Laizure, C. McK., Mineral resources of Mariposa County, Report XXIV of State Mineralogist, p. 145, 1928.

tons per day, produces water-floated, ground barite which is being utilized in the preparation of 'Baroid' for weighting oil-well drilling mud. According to statements from the National Pigments Company, which owns the patent for it, 'Baroid' is non-settling because of its fine particle-size and the "incorporation of a small amount of concentrated colloidal suspending agent in the finished product"; so that baroid will not settle out of the mud-fluid when circulation in the oil well is suspended, "even though the fluid be left standing for months." It is proposed later to add acid-bleaching equipment to this grinding plant. At present, none of the witherite ore on the north side of the river is being mined.



Mine workings and tram-loading terminal of National Pigments Company on south side of Merced River, Mariposa County. Photo by E. H. Murchison.

Egenhoff Group. Located by W. D. Egenhoff of San Francisco in 1917, and recently sold to the California Barium Corporation. It consists of three claims on a deposit five miles by trail from Jerseydale or six miles in an airline south from the nearest point on the Yosemite Valley Railroad. Barite occurs in ledge form, between limestone hanging wall and quartzite footwall. It has been traced for a length of at least 4500 feet, and prospected by several cross-cuts, but its size is not yet fully determined. Transportation is at present the principal difficulty. A compressor and other equipment was installed in October, 1929, and development by tunnel is planned.

Monterey County.

On the slopes of Gabilan (or Fremont) Peak along the line between Monterey and San Benito counties, there were a number of lenses of barite from which quite a tonnage was shipped during the years 1916 to 1920, inclusive. The barite lenses were associated with silicified limestone and with dolomite. The barite mined was white and especially high grade, analyses showing 98%–99% $BaSO_4$. The lenses were apparently small, as there have been no further shipments. The material was hauled by motor truck to the railroad at San Juan Bautista, a distance of 9 miles.

Nevada County.

The Democrat Barytes Mine, 7 miles by road from Dutch Flat, is now owned and operated by the Chemical and Pigments Company, Inc., of 766 Fiftieth avenue, Oakland. This deposit was first worked in 1919 by Bear Barytes Company, and in 1920 it was taken over by the Metals and Chemicals Extraction Company, who operated it for three years. The present owners began shipments in 1926.

The outcrop of the deposit, which has been mostly removed by mining, was in the shape of a dome or knob on the point of a steep ridge overlooking Bear River.[10] Of irregular shape, it varied in width from 15 to 24 feet at the surface and had a length of 250 feet, rising about 60 feet at the highest point above the level of an old ditch.

The ore of commercial grade (showing in part up to 98% $BaSO_4$) passes into an impure barium-aluminum silicate rock on the north, and on the hanging-wall side there is no regular contact between ore and rock. The barite varies in color from pink or gray to black (due to carbonaceous matter), and is nearly all more or less 'off color' when ground, requiring chemical treatment.

Mining for several seasons was by open cut, and later by a cross-cut adit (100 ft. level). At present, ore is mined through a series of five raises put up from the 30-foot level into the bottom of the old cut. From this level it is dropped to the 100-foot level and trammed to the loading bin at the tram terminal, thence hauled by 5-ton trucks to the railroad at Alta, six miles. For transporting the ore across the steep canyon of Bear River, there is a gravity aerial tram 1800 feet long with 2-ton bucket. The ore has been mined for 250 feet in length on the surface, and the 30-foot level is 200 feet long. In August, 1929, eleven men were employed and shipments were at the rate of 100 to 150 tons per day. The working season is ordinarily five or six months. Mining equipment includes a 4-drill compressor, operated by a gas engine, air drills, mine cars, and a blacksmith shop.

Spanish Barytes Deposit.[11] Spanish Mining Company and San Francisco Commercial Company, owners, care F. W. Bradley, Crocker Building, San Francisco. It is in the NW¼ Sec. 19, T. 18 N., R. 11 E., 5 miles by road west of Graniteville.

The outcrop of the deposit is on the line of the old North Bloomfield ditch, at an elevation of 4600 feet. When first visited by C. A. Logan in 1919, the outcrop was examined for a length of 330 feet. The color of the freshly broken rock is white to creamy white, and the quality as shown at the outcrop appeared to be good throughout; but the joints and bedding planes at the surface are coated with bright red layers of iron oxide, sometimes over one-eighth inch in thickness. No work had been done on the deposit at that time, but it was so promising that only the distance from railroad prevented its development and utilization.

Since that time, prospecting done by the owners has developed a deposit which is claimed to contain several hundred thousand tons of barite. A cross-cut run at a depth 280 feet vertically below the deposit (aneroid measurement) either bottomed it or indicated it had

[10]Logan, C. A., district engineer, California State Division of Mines, Unpubl. MS.
[11]Logan, C. A., *Idem.*

been cut off by a fault. Of this possible faulting, however, there was no evidence when the workings were visited. No barite showed at this level where the country rock is Carboniferous slate and schist. The barite was prospected by a raise 400 feet long on the dip to the surface, which is reported to show barite all the way, in places 15 feet thick and up to 7 feet wide on the surface. Stripping has shown the deposit to extend considerably farther than indicated by the outcrop. It strikes north. No commercial shipments have been made. Considerable prospecting for other ores has been done on the claims near the barite deposit.

Nevada City is 27 miles distant via the North Bloomfield road and 24 miles by way of Washington. This connection, however, would be with the narrow-gauge railroad, requiring more expense for transfer to broad-guage cars, at Colfax. The truck haul from the deposit to the Tahoe-Ukiah highway (which connects with Emigrant Gap on the broad-gauge railroad as well as with Nevada City) would involve a descent of 1800 feet vertically to Washington, then a climb of 1500 feet in vertical distance in four miles, with another climb from Bear Valley to Emigrant Gap, which is 20 miles from the deposit.

The occurrence of off-color barite is noted near *Wolf*, and also near the *Liberty Hill* hydraulic mine.

Orange County.

On Red Hill, 2 miles east of Tustin, cinnabar occurs in Tertiary sandstone, with a barite gangue. On the north side of the hill, there are a number of small veins, and material from these was treated in retorts in 1927 for the extraction of the quicksilver. The calcined residue, barite, was sold to oil companies in one of the nearby oil fields for heavy-mud use in oil-well drilling operations.

San Benito County.

(See under Monterey County.)

San Bernardino County.

Barite was common as a gangue in the silver districts of Calico and Barstow, and at the Imperial Mine. It occurs 6 miles north of Barstow; a deposit is reported near Ludlow; one at Foshay Pass, southeast of Kelso; two miles southeast of Afton; four miles north of Daggett; and 12 miles east of Victorville [12]; and in the Avawatz Mountains.

Shipments aggregating over 500 tons were reported by two producers in San Bernardino County in 1929, John Kennedy of Daggett and Ellis Mallery, Los Angeles. The latter owns the *Barium Queen* mine, five miles northeast of Barstow, in T. 10 N., R. 1 W., S. B. M. Barite occurs in a series of parallel veins which strike N. 30° W., and dip 70° NE., cutting quartzite and schist. The main vein is 4 ft. to 5 ft. wide.

Hansen Deposit, owned by H. B. Hansen of Los Angeles, is in the Lavic Mining District in T. 8 N., R. 8 E., S. B. M., three miles north of Ludlow. It is under lease to H. A. Hukill, Ludlow. There are four claims, covering approximately 80 acres. There are 8 parallel veins, occurring in basalt, with strike N. 45° W., and dip 45° E., and

[12] Report XVII, p. 334, 1920.

the vein filling consists of barite and hematite. Development work, thus far, has been on only one of these veins, which is 3 ft. to 14 ft. wide, with an average of 6 ft. The ore shoot is 150 ft. long, and has been stoped from the 50-ft. tunnel level to the surface. The ore shoot occurs at the intersection, along the strike, of this vein with one dipping in the opposite direction. The vein is faulted at 150 ft. from the portal in the adit, which has been driven 250 ft., at 60 ft. below the outcrop. A total of 60 cars of crude barite has been shipped to Los Angeles for use in oil-well drilling mud. The material is stated to range from 4.33 to 4.39 sp. gr., and carload lots average 4.25 sp. gr.

Cooper Shapley of Bishop, Cal., has leased the mill-tailings dumps on several of the old silver mines near Barstow, including those of the Waterman, Run-over, and Waterloo mines. The material passes 100-mesh screen and averages 23% $BaSO_4$. A 100-ton per day flotation plant with K. & K. machines has been built, and 20 tons of barite concentrate is made daily. Mr. Shapley has a patent for the principal flotation reagent employed, which was developed originally for the flotation of fluorite. The resulting concentrate has a specific gravity of 4.3, and carries 3 oz. silver per ton. Analyses by Wilkinson & Barks show: SiO_2, 1.83%; Fe_2O_3, 1.35%; Al_2O_3, 1.79%; CaO, 4.13%; MgO, none; $BaSO_4$, 90.5%–93%; PbS, none. The concentrate is being shipped to Los Angeles for oil-well mud.

Witherite is reported by T. G. Nicklin of Barstow, as occurring in a deposit associated with strontianite.

Santa Barbara County.

La Brea Deposit[13] (formerly *Eagle Mine*), Chas. Smith, John Mahurin and Fred Shaefer, Santa Maria, owners. This property was recently under lease to La Brea Barytes Co., E. B. Smith, president, Oakland, Cal. The group consists of four claims, Eagle Nos. 1, 2, 3, 4, in Secs. 5 and 6, T. 10 N., R. 30 W., S. B. M., on the North Fork of La Brea Creek 20 miles northeast from Sisquoc, or 27 miles by road. The outcrop of the vein was on a ridge east of the north fork and 800 ft. elevation above the creek.

The lessee built 23½ miles of road up La Brea Creek Canyon and 3½ miles of road from the canyon to the deposit. The outcrop showed a vein of massive white barite, for a length of 200 ft., averaging 20 ft. in width, strike E. and W., with steep dip N., ocurring in tough gray sandstone and gray shale. On the surface, this appeared to be one of the largest known deposits of barite in the state, but mining operations revealed the fact that the 'vein' pinched out at a depth of only 30 ft. A number of small outcrops occur along the ridge for a distance of 2000 ft.

The ore was mined from an open-cut 150 ft. in length, by 20 ft. wide by 30 ft. deep, and was trammed to a 50-ton loading bin near each end of the cut. From May, 1929, to March, 1930, a total of 4000 tons of barite, averaging 97% $BaSO_4$ and specific gravity of 4.3, was shipped to the California Talc Company at Los Angeles, where the material was ground and mixed with bentonite for use in deep-well drilling in

[13] Tucker, W. B., district engineer, Los Angeles. Unpublished MS.

the Kettleman Hills and Ventura oil fields. From the several small scattered lenses possibly an additional 1000 tons of barite could be mined, but it would require sorting, so that there is doubt if it would pay on account of the distance to the railroad loading point, 30 miles. The lease has been surrendered and the property has reverted to the owners.

Shasta County.

Austin Quarry. H. C. Austin operated a quarry in Sec. 29, T. 34 N., R. 3 W., near Copper City, some years ago. The Glidden Company of California mined some barytes from this section, but found the grade of the material low. Section 29 is now assessed to the Central Pacific Railroad.

Exposed Treasure No. 1 and No. 2 Claims, formerly held by C. A. Packwood and Alonzo Luce, are now held by D. G. Taylor and Elmer C. Bryner of Wengler, and are optioned to C. A. Hill of Ingot. State Mineralogist's Report XXII states that this deposit is in Sec. 33, T. 36 N., R. 1 W., which is now assessed half to the Central Pacific Railroad and half to the Mount Shasta Power Corporation.

The claims are two miles west of the old Benton saw mill and three-quarters of a mile east of Pit River. The distance from Redding, the nearest railroad point, is about 50 miles, of which a half mile is trail. The prospect is about a quarter of a mile west of and several hundred feet below the edge of the plateau formed by the Tertiary lavas. These have been eroded away; and the barite is in a fracture in the underlying formation, a decomposed basic igneous rock, probably diorite.

Development consists of a 12-foot shaft on a vertical vein of barite, striking north and south, with a maximum width of a little over two feet. The barite is nearly white, and apparently of good quality. The same vein is exposed in a gulch 100 feet to the north; and pieces of float are found between the shaft and this gulch.

The long truck haul makes the commercial value of this deposit doubtful at present market prices, even if a larger width and tonnage were developed.

Two miles to the northwest of this prospect, near the Modem property across Pit River, and on the slope draining into Squaw Creek, a larger deposit is said to occur, which, however, is not developed, and is in a location difficult of access.

Glidden Company of California, 1300 Seventh street, San Francisco, has taken over the property formerly known as the Loftus Barytes Prospect in Sec. 18, T. 38 N., R. 3 W. Three claims, known as Barite No. 1, Barite No. 3, and Marion, have been patented under Mineral Survey 5906. The deposit is 7 miles by trail from Castella, at an elevation of 5000 feet; but a cable tramway, less than half as long as the trail, can be built to drop the ore down to the railroad directly below at an elevation of 2000 feet.

The deposit lies just west of the extensive limestone beds that form the ridge of this mountain range, and apparently dips under the limestone. A width of 60 feet is exposed; but the depth is unknown, because only sufficient development work has been done to obtain the patent.

The barite, stated to analyze 97% $BaSO_4$, is of excellent quality, with the exception that it has a blue-gray color that will not bleach out under the ordinary treatment with acid.

At 1500 feet south of the deposit just mentioned, the barite outcrops again; and the railroad land has been purchased by The Glidden Company of California as follows: Lots 2, 3, 10, 11, E½ Lot 4, NW¼ Sec. 19, T. 38 N., R. 3 W.

Barite also occurs in the gangue of the zinc-copper ores in the mines at Bully Hill, now controlled by the Glidden company; and consequently the tailings stored from past operations show quite a percentage of barite.

Noble Prospect (Barite No. 1 and No. 2 claims) is now held by Don Noble of Platina. The location is in Sec. 28, T. 29 N., R. 9 W., 3 miles from Noble Station by road and trail, of which 2 miles is trail. Noble Station is 42 miles from Redding and 44 miles from Red Bluff, both on the railroad.

A 5-foot width of barite is exposed in a cut 10 feet long. At the time of visit[14] the bottom of this cut was full of broken rock and dirt; and the formation could not be observed. Mike Malone, who did the work in the deepest part, stated that a fault was struck in the bottom, and that the rock beyond the fault was not barite. The steep side of the gulch suggests the possibility of a slide. The strike of the barite indicates that it should cross the creek at a distance of 100 or 200 feet from the cut; but prospecting has failed to reveal such a crossing. Small amounts of witherite have been found with this barite.

About two miles of road must be cut in steep hillsides to reach this deposit; and the present state of its development does not justify the expense of building such a road. Even if this road were built, the 45-mile truck haul to the nearest railroad point is prohibitive at the present market price of barite.

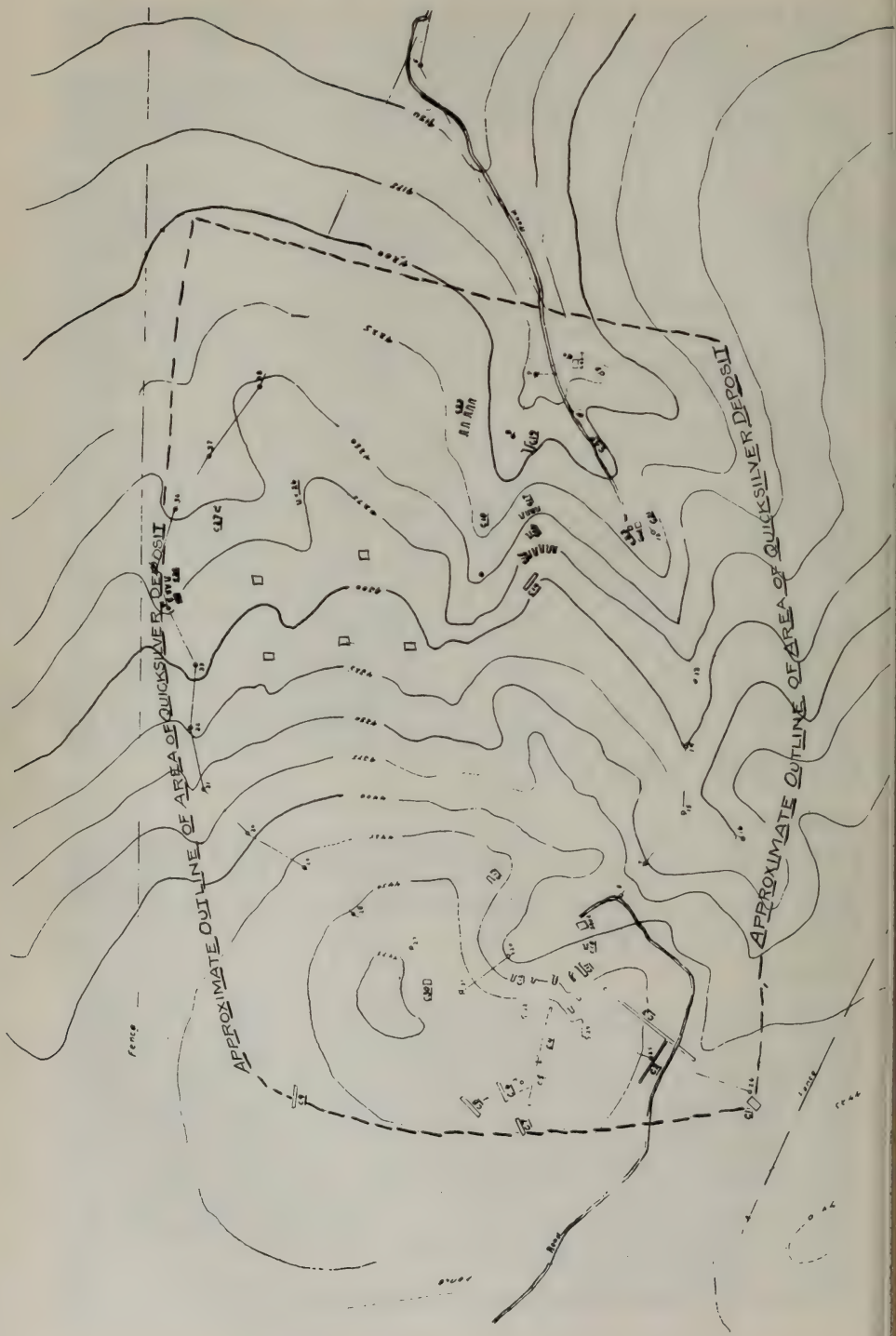
Stanislaus County.

Barium Products, Inc., has a plant at Modesto which is manufacturing a number of chemical products among which they include some of the barium compounds. They use barite from the deposit at El Portal, Mariposa County.

Summary.

Californian resources in barite are ample to supply the present Pacific Coast market demands, both for ground barite and for lithopone; and they are apparently ample for any considerable increase that may occur as our population and coast industries advance. Previous to 1920, when the first plant in California for preparation of lithopone began operations here, it was not possible to dispose of anything but a high-grade, white, dry-grinding crude; but now, with two acid-treating plants available, there is a market for off-color grades of the crude mineral. With deep drilling in high gas-pressure areas, the demand for barite in oil-well mudding appears to be increasing in certain Californian oil fields.

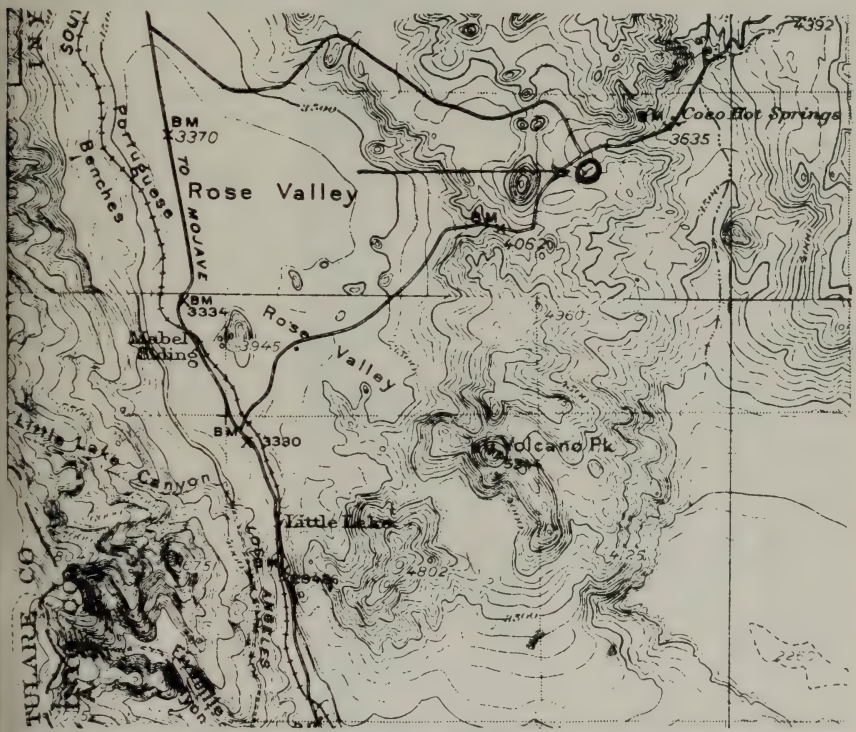
[14] Averill, C. V., district engineer, Redding. Unpubl. MS.


APPROXIMATE OUTLINE OF AREA OF QUICKSILVER DEPOSIT
APPROXIMATE OUTLINE OF AREA OF QUICKSILVER DEPOSIT

MERCURY DEPOSIT IN COSO RANGE, INYO COUNTY, CALIFORNIA

By Thor Warner*

Recent discovery of quicksilver ore in southwestern Inyo County reveals a condition of mercury occurrence closely associated with thermal waters. History of Coso health springs antedates early mining of California quicksilver and subsequent research brings forth interesting data in development of sulphur deposit, of volcanic steam for power purposes, of medicinal water and mud, and of a substantial mercury deposit of no small proportion.



Section from U. S. Geol. Surv. topographic map showing topography surrounding mercury deposit.

Description of Area..

The area under attention is situated 2½ miles southwest from Coso Springs, in sections 7 and 8, T. 22 S., R. 39 E., M. D. M., Inyo County, California. The Southern Pacific Railroad passes to the west and through Owens Valley, and Coso Springs can be reached over a fairly good desert road from Coso Junction, the distance being 11 miles. The road crosses a range of mountains through a pass that reaches an eleva-

*Consulting Geologist, Los Angeles, Cal.

tion of 4000. The elevation of Coso Springs is 3600 feet, while the railroad junction reaches an altitude of 3450.

General and Structural Geology.

The area is situated in the midst of a geological province that in past ages has been subjected to volcanic activity. The rock formation in this region is largely of plutonic and volcanic origin. The core of Coso Range is granite with overlying lavas of different ages. While the basins and depressions are covered with younger material, these deposits are only veneers, and represent disintegrated rocks of the higher elevated areas.

On the west side of Coso basin, which covers approximately one square mile, a feldspathic granite forms the eastern flank of one of the many smaller ranges of Coso Mountains, and this formation evidently extends eastward and underlies the black basaltic lava on the east fringe of the basin.

One mile north of Coso Springs and on the west side of the narrow gap which extends northeasterly from the basin, the east flank of the range consists largely of a hornblende-granite, with basalt boulders in the wash below.

The east side of the basin, as well as the narrow gap heading northward, is covered with basaltic lava which forms a complete contact with the granite along the canyon wash. These conditions exist as far north as the examination extended, a distance of 3 miles from Coso Springs proper.

The black basaltic lava forms the boundary of Coso basin on the northeast, east and southeast. The structural condition of this lava is of interest because of the fact that near the edge of the basin granite can be seen in places where the lava has been eroded away. The deposition of the lava has produced a terrace effect on the surface and its estimated altitude reaches 1000 feet above the basin.

On the summit of the range west of Coso and in the immediate section adjacent to the area here under consideration, the range is partly covered with another kind of lava which seems to be a very siliceous rhyolite. This material is at least 300 feet in thickness in and along the south side of the road leading out over the range.

Mercury Deposit.

In sections 7 and 8, and about 2½ miles southwest from the Coso Springs, is situated a conical hill that arises 300 feet above the mountain pass. The formation at this place is rhyolite, partly metamorphosed and badly disturbed. The entire hill has undergone an alteration through the ascending steam vapors. The knob is traversed by several deep ravines. The major portion is still in a heated state, with emitting steam vapors and at least two living springs of boiling waters.

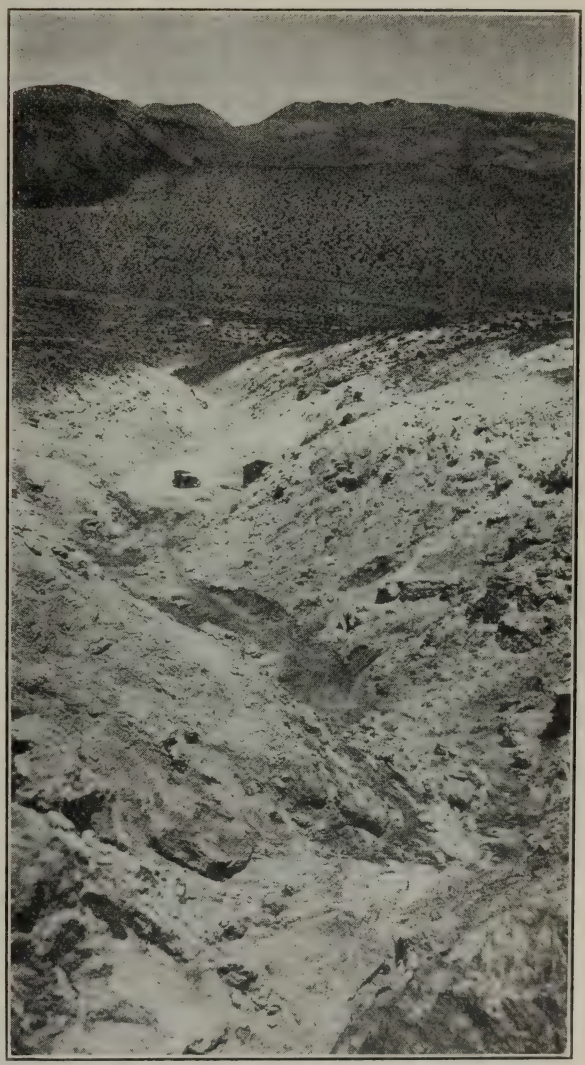
Near the apex of the hill, a large crater-like opening is crossed by a network of veinlets, seams, crevices and fractures, through which have been deposited the cinnabar crystals and free sulphur.

Near the southwest corner of section 5 a narrow wash leads off to the south boundary where, in a few hundred feet, it enters the mouth of Devil's Kitchen Canyon. A short distance further on, the canyon splits into three forks or ravines, the main one continuing in a southerly

direction while the easterly splits into two forks which extends well into the hillside. The westerly ravine ends in a large basin with numerous smaller gullies extending into the edge of the hill. The larger canyon continues in a southerly direction and along this part are several steam-vapor springs of acid water.

The slopes of the canyon sides lie at an angle of about 45° and these will measure along the slope angle from 40 to 120 feet. These talus-fans, are made up of a fully-disintegrated and finely-granulated material of almost a beach-sand mesh. The color of this mass deposit ranges from jet black (metacinnabarite) into brownish and in places from canary to scarlet. The average blended color, such as obtained in the sampling, is not unlike an ash of light reddish tinge. At various points a more solid material occurs.

Sulphur having been one of the major contents of the vapors now escaping, occurs prominently throughout the whole area and especially so near the surface and at the head of Devil's Kitchen Canyon, where an attempt has been made to mine the sulphur separately.



View of Mercury deposit looking north from head of Devil's Kitchen Canyon, in Inyo County, California. Photo by Author.

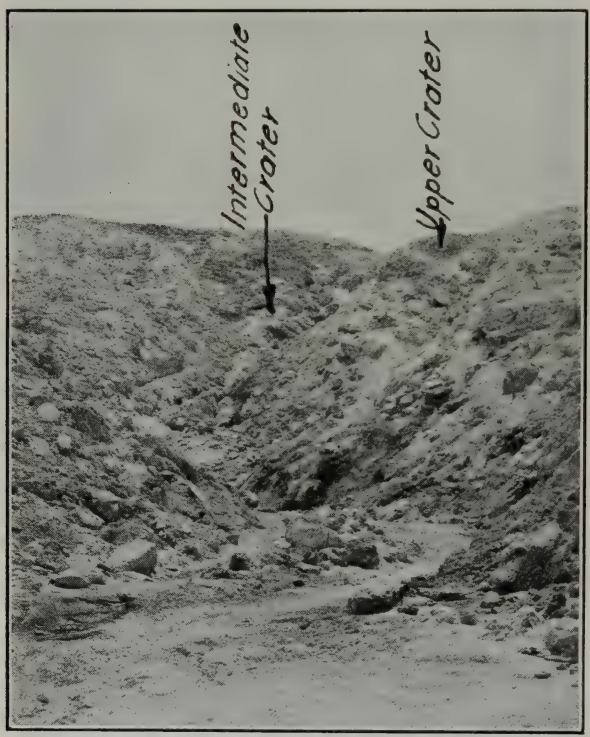
Origin of Deposit.

Deep-seated disturbances in the granitic core of the range have extended over long geological periods and over broad and far-reaching areas. The result of much dynamic activity leaves a faulted and fractured condition which, in some instances, does not extend beyond the

rock strata immediately adjoining the center of action. Again, the overlying rocks are affected and sheared into blocks of varying dimensions.

In this area, there is a veneer of rhyolite, which has also been fissured and fractured so extensively that there is a complete network of seams and openings. Such a condition permits the invasion of percolating vapors and liquids, carrying mineral contents in suspension.

In the latter part of 1926, the writer had occasion to make a study of the region tributary to the Coso Hot Springs, which is located 2½ miles in a northwesterly direction from the area forming the basis of this description. The springs proper are situated along a north and south striking fault line and along this fault has been deposited, through the agency of thermal waters, a clay which has a medicinal value. The formation along this line of springs and fumaroles is granite which has undergone an alteration or kaolinization whereby the feldspar components have become changed into clay.



View of Devil's Kitchen Canyon looking south. Sample pits on both sides of canyon show occurrences of mercury. Photo by E. J. Sanders.

Rhyolite being the surface rock at the point where the mercury deposit is situated contains about 70% silica, has been altered to a granular mass, due to the attack upon it of acid-bearing vapors, and thus paved the way for the dissemination of mercurial fumes.

That the escaping fumes and vapors from the many springs and vents along the canyon carry mercury in appreciable quantities is attested to by the following test: A polished copper plate, 4x12x$\frac{1}{32}$ of an inch thick, was placed over a small chimney, hurriedly arranged from pieces of rock, and in a few minutes there was a substantial mercury coating. The possible recovery of mercurial fumes in such way may be of interest in ultimately producing mercury through the installation of a series of traps.

Mercury Contents and Exposed Ore.

Three different areas showing depositions of mercury occur within short intervals on and near the summit of the mountain pass. In each

instance the heated ground gives one the clue to the presence of ore. Two of the three areas have been subjected to development in the form of surface excavations. The major amount of work is centered in Devil's Canyon, where the erosional agents have accomplished a good portion of such preliminary development as must precede actual mining of any surface orebody. In addition to such exposures as have been sculptured out by nature itself, many pits and trenches have been cut into the canyon sides and from these samples of material were cut for assay purposes.

Several hundred hand samples were taken at various points and consolidated into two samples—high-grade streaks having been eliminated, in order to ascertain possible mercury value in bulk of exposures. These samples gave a return of 0.16% and 0.19% Hg, respectively. Samples cut in 2 to 4-foot sections gave returns of 2% to 3% Hg, and with a few assays from highly enriched smaller streaks of even higher values. (Samples of selected ore carried from 7% to 11% Hg.) An attempt was made at first to ascertain values by panning, but as much of the value seemingly occurs in the form of metacinnabarite, this method did not give a satisfactory guide in sampling, and to anyone not familiar with the blending of these various forms of mercury, the surface appearance of the exposures is most bewildering.

The Devil's Kitchen Canyon, with tributary ravines and gulches, covers an area of 65 acres. The exposures of available orebody embrace at least one-half of this acreage, which attains a thickness of nearly 300 feet at the head of the canyon and tapers to a feather edge near the mouth, but at which point no development has so far been undertaken to show the depth beneath the canyon level. The distance from the mouth of canyon to the apex of the hill is 1200 feet. In places the orebody is covered with unaltered rhyolite in thickness from 1 to 20 feet. From surface exposures this area contains an approximate minimum of one million tons of possibly commercial ore.

The second area of enrichment lies one-half mile northeast of Devil's Kitchen, and embraces about 40 acres and is locally known as the Nicol's property. This is a basin hemmed in on all sides by high hills. Between this basin and Devil's Canyon a ridge of hornblende-granite strikes northerly and southerly. The road over the Coso range from railway to Coso Springs passes through this basin. Some twenty pits have been sunk over half of the basin area, some of which attain a depth of 8 feet. A thin veneer of surface debris mingling with iron oxide covers the mercury-charged material, which is a highly kaolinized rhyolite. The area is hot in certain places and at one point covering about one acre, steam vapors are evident. Samples taken in sections from 2 to 5 feet in thickness gave the following assays:

0.49% Hg. 1.64% Hg. 0.36% Hg. 0.13% Hg.

The third area of high temperature is at the foot of an extinct crater one-half mile northwesterly from Devil's Canyon. No work has been done here aside from one small pit, which shows the presence of mercury-charged material.

The property is owned by F. J. Sanders and Carl W. Rodecker of Los Angeles.

AERIAL PHOTOGRAPHY AND ITS IMPORTANCE TO CALIFORNIA GEOLOGISTS

How and Why Aerial Pictures and Mosaic Maps Are Made, and What the Geologist Looks for in Them; Also Some Other Uses for Which They Are Adaptable.

By Leon T. Eliel *

With eyes three miles above the ground, and a half a mile or more apart, the modern geologist has found in the airplane and its mapping camera a new point of observation and practically a limitless horizon. These remarkable eyes make a permanent record for him of great tracts of land which may be mapped in a surprisingly brief period of time.

Through a hole in the floor of the airplane the mapping camera records its pictures at such intervals that each overlaps the other by usually 60%. Down one strip the airplane may fly recording a band of territory two or two and one-half miles in width. At the end of this strip it flies back along a parallel course taking a second series of pictures overlapping the first, end to end, so that the entire territory is amply covered.

With the aid of an instrument known as the stereoscope two successive 7″ x 9″ pictures may be superimposed before the observer's eye, rendering an effect of plastic relief. This stereoscopic vision is one of the most valuable features of aerial surveys from the geologist's standpoint. With the ground before him in perfect miniature, the completeness of the detail is difficult to imagine. In addition to using these pictures stereoscopically, large areas may be made into a composit map known as a mosiac. Such maps may be made up to any desired degree of accuracy, and serve as an admirable base map on which to compile the geological data. Furthermore the continuity afforded by the mosaic map makes it possible to view at one glance hundreds of square miles of territory, if desired, so that faults, contacts and other topographical features may be followed through their entire extent.

It is advantages such as these which have caused geologists in California and the western part of the United States to have mapped nearly 20,000 square miles by aerial photography during the past year.

[1] In California, where aerial maps for this purpose have probably had their most intensive application, practically every major oil company has tried out the method and reported favorably upon it. While in the main the application of aerial maps to geological problems in California has been successful, it can not be said that the application is universal and suitable to all California structure.

In all countries of bold relief where the surface topography reflects subsurface conditions, the aerial photograph has unquestionably proven its utility. Thus on the rim of the San Joaquin Valley thousands of square miles have been recorded in this manner and have given an

*Leon T. Eliel, Pacific Coast Representative of Fairchild Aerial Surveys, Inc.
[1]See Oil Bulletin (Los Angeles), Nov., 1929, p. 1177.

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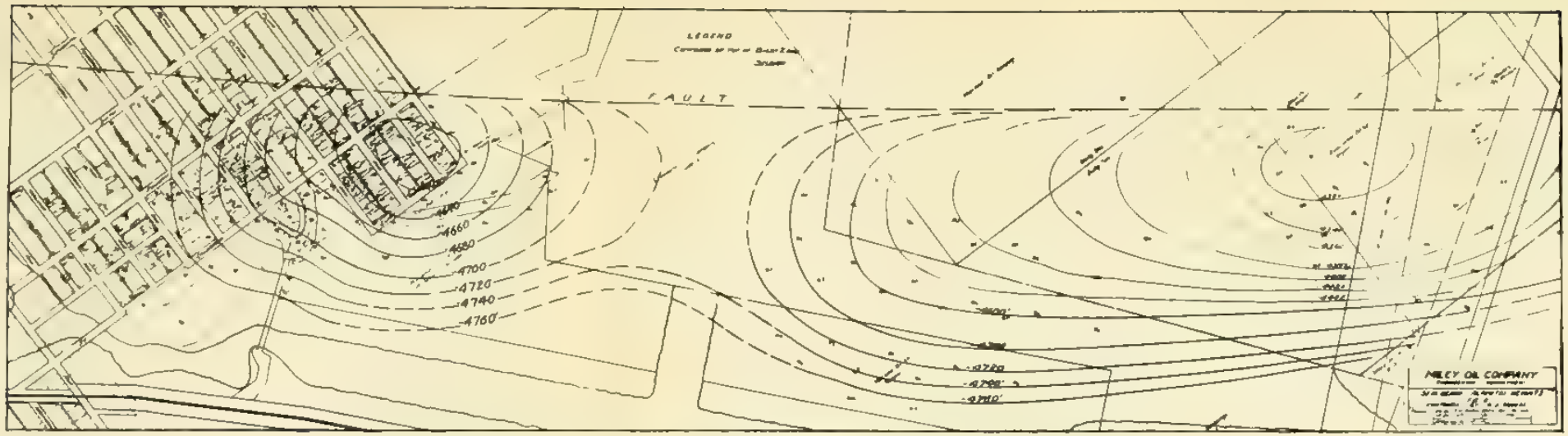
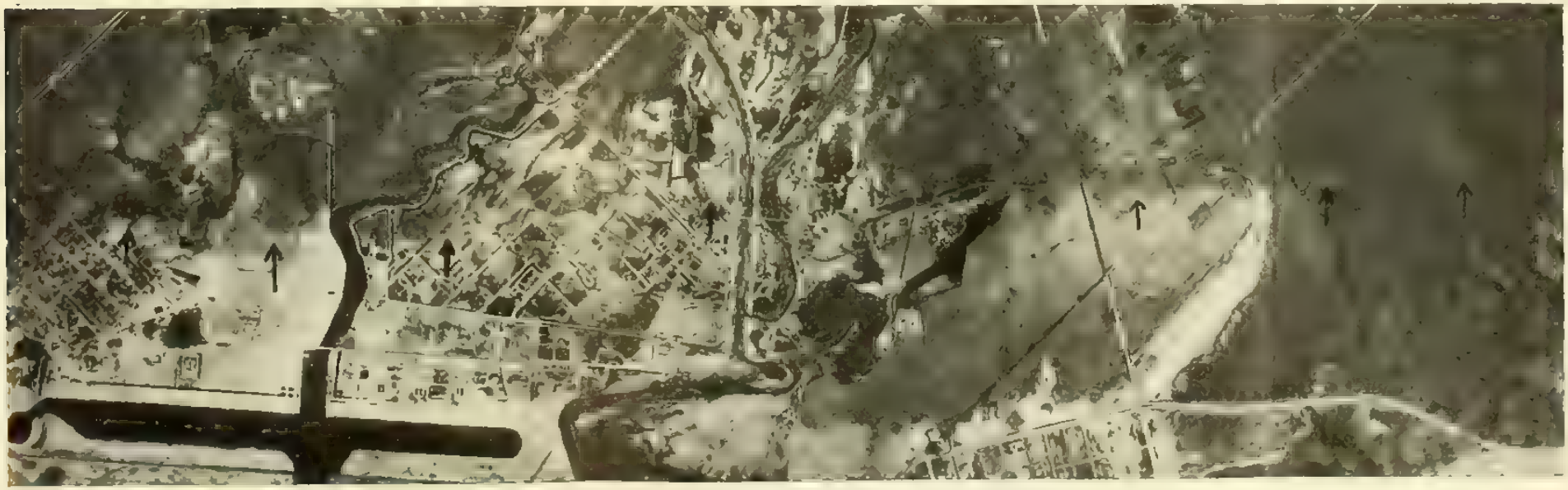


CONTOURS OF THE BIXBY AND SELOVER ZONES SEAL BEACH-ALAMITOS HEIGHTS

This map, which was prepared by the engineering department of the old Miley Oil Company, and originally published in the July, 1927, issue of OIL BULLETIN, not only indicates the contours in the Seal Beach and Alamitos Heights oil fields, but shows the fault which has been found to extend through this area, setting the limits of these two fields on the north side. The map covers a portion of the territory shown in the photograph which follows.



TRACING A FAULT BY MEANS OF AERIAL PHOTOGRAPHS

Even in a flat country such as the Alamitos Bay district a fault may betray itself quite definitely by color and topographic displacements. Arrows point to the fault. This photograph, taken from a height of 15,000 feet, shows the Alamitos Heights and Seal Beach oil fields together with a considerable expanse of country to the south and east of them. Alamitos Heights is at the extreme left of the photograph and Seal Beach is just to the right of the center in the foreground.

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extremely valuable addition to information which was secured by ground studies, in addition to facilitating a speedy preparation of the geological reports.

The same observations may be made in relation to the country in the vicinity of Ventura. In this country of bold relief, faults, contacts and bedding show quite distinctly on the aerial pictures, which have aided materially in working out complicated geology.

In flatter country the answer is not so easily given. To be sure, along the fault through Huntington Beach, Signal Hill, Inglewood and on into Beverly Hills the aerial map quite definitely traces the rift. There are regions in the flat between Huntington Beach and Signal Hill where very little surface evidence of the fault exists to the observer on the ground, while the fault may be traced quite definitely from the pictures. In valleys which have had the natural topography and foliage changed by cultivation the evidence which may have existed on the virgin ground is often eradicated. However, even in spite of cultivation it is not infrequent to find faults which can be quite definitely traced through these areas. The evidence may be in the form of stream displacements or it may be in the form of changes in soil color on opposite sides of the contact.

In types of country like some parts of west Texas the aerial photographs have not given a very good account of themselves from the geologist's point of view. In many of the flat areas the structure proper is so hidden by the overlying Cretaceous formation that there is little on the surface for the pictures to reveal. However, on the margins of such flat areas or where any surface topography of marked relief occurs, subsurface conditions should be reflected by surface topography even through a thick Cretaceous covering. Various areas in Texas would have to be considered separately, as quite a few are very definitely subject to satisfactory study by aerial photography while other regions appear to be quite hopeless.

In jungle country air maps have demonstrated their effective application in a number of instances. If there are any rock outcroppings they become apparent in the photographs because of the scarcity of vegetation. Oil seepages in a similar way are apt to be reflected in the vegetation. Naturally the drainage can be readily followed on the photographs, and is indicative of any anticlines or folds which may exist. Although much of the ground evidence is, of course, hidden by the foliage, enough is usually shown in jungle pictures to justify aerial maps. In country where the vegetation is so dense that an observer might walk within ten or fifteen feet of an important bit of geological evidence and not see it, it is quite obvious that any assistance that the camera may render is most welcome.

The things which the geologist sees in the aerial picture and which may be interpreted by him as of geological significance may be listed as follows:

Anticlines or geological highs are usually distinguishable on aerial maps in a number of different ways. In the first place if there is no other evidence radial drainage usually suggests the location of a high. If the country is of bolder relief the anticline may show very distinctly as a closed structure or it may be suggested by the dipping beds, the interpretation of which is aided by stereoscopic observation.

This mosiac map splendidly illustrates geologic data secured from aerial photography. Outcropping beds can be easily traced from the hilly territory in the lower left corner of the map into the cultivated area to the right. In some instances traces of these beds are discernible where

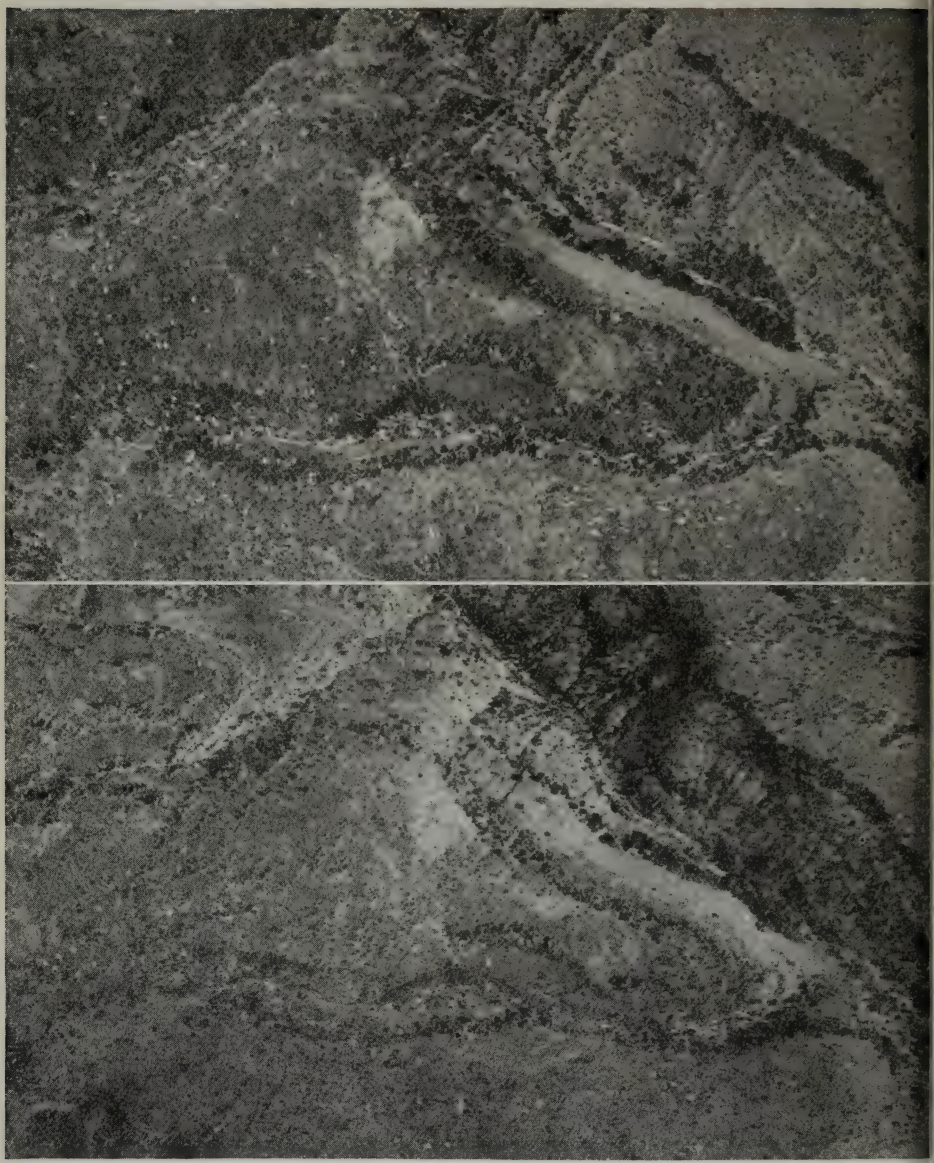
This use of the stereoscope, by means of which sections of the area can be viewed in plastic relief like a miniature model, is of inestimable value in placing the proper interpretation on the pictures. The anticline may further be suggested by the arching of streams which make their way through the structure following the bedding planes. In flatter regions the anticline is occasionally revealed by the plan form of the eroded beds.

Contacts may often be picked up on the aerial map when they are not apparent on the ground. For instance, it is not unusual to be able to follow contacts through fields of standing grain. This is often possible because the two different types of soil on opposite sides of the contact sustain a different density of vegetation. This density is reflected in a change of tone or color on the photograph. Of course, the contact frequently becomes apparent because of the difference in soil color itself, and at other times its position may be ascertained from the change in character of the natural vegetation. This latter condition was particularly obvious in the Poso Creek region in California, where the change of foliage, supported by the sedimentaries and the granite, was quite marked and enabled the contact line to be placed from the aerial pictures quite accurately.

Faults may often be picked up as a result of the same evidence which reveals contacts. In other words, a fault line may often be a contact line. At other times a fault may be picked up readily because of an alignment of topographic features at variance with the general drainage or topography of the region. The escarpment itself is often very obvious in the aerial pictures, particularly if the pictures are taken at a time of day when the shadows accentuate the topography. Of course, displacement of streams is one of the most definite indexes to a probable fault. Sometimes the fault may be picked up by a slight color variation of the photograph. This may be due to the fact that the gouge affects the character of vegetation, or it may be due to the fact that the gouge is actually of a different shade or color than the soil on either side of the fault line. Although in the main most important faults can be readily picked up on the aerial maps and often can be found by their aid when they are not apparent on the ground, the converse also holds true. For instance, in the Kettleman Hills region of California there are some very important faults which have been the scene of major earth movements running into thousands of feet. Some of these faults have been worked out on the ground which absolutely did not show in the aerial maps owing to the fact that they were hidden by surface deposits and erosion.

A great deal has been learned relative to the variance in the appearance of aerial photographs on account of the time of day and the season of the year. For instance, in the fall and winter when the grass covering may be dead, and all of a similar shade of brown, the photographs become flat to an unbelievable degree. Contacts and other information, which might be quite obvious during the spring when everything is fresh and varicolored green, can not be detected.

The time of day at which the aerial photographs are taken often is a matter of prime importance. If topographic features are the main purpose of the aerial map the pictures should be taken either early enough in the day or late enough so that shadows show prominently.



TIME OF DAY IS IMPORTANT

Two photographs of the same area. The upper one was taken at noon and the lower at 5 p.m. The necessity of selecting the proper time of day from the standpoint of shadows is well illustrated here. (See text below.) These photographs were taken from a height of 10,000 feet.

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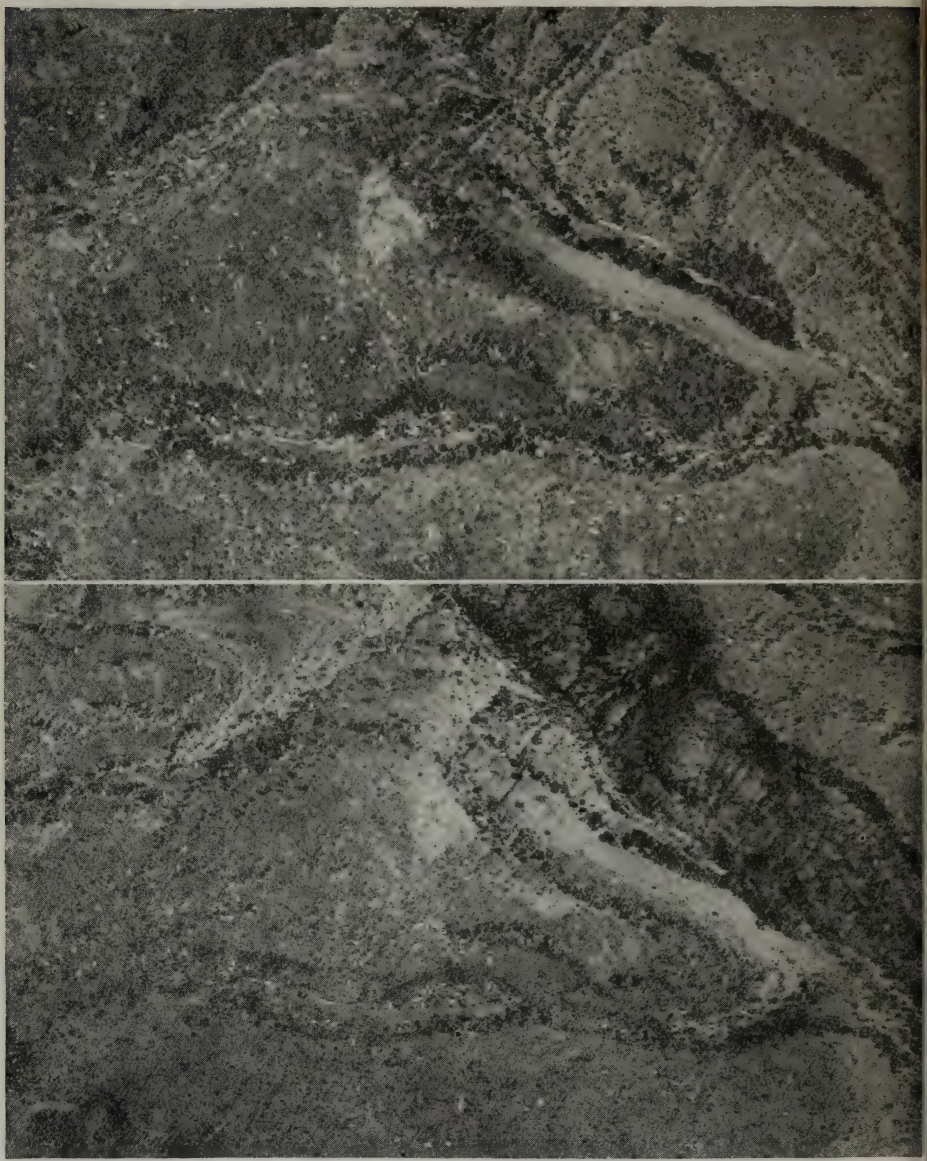

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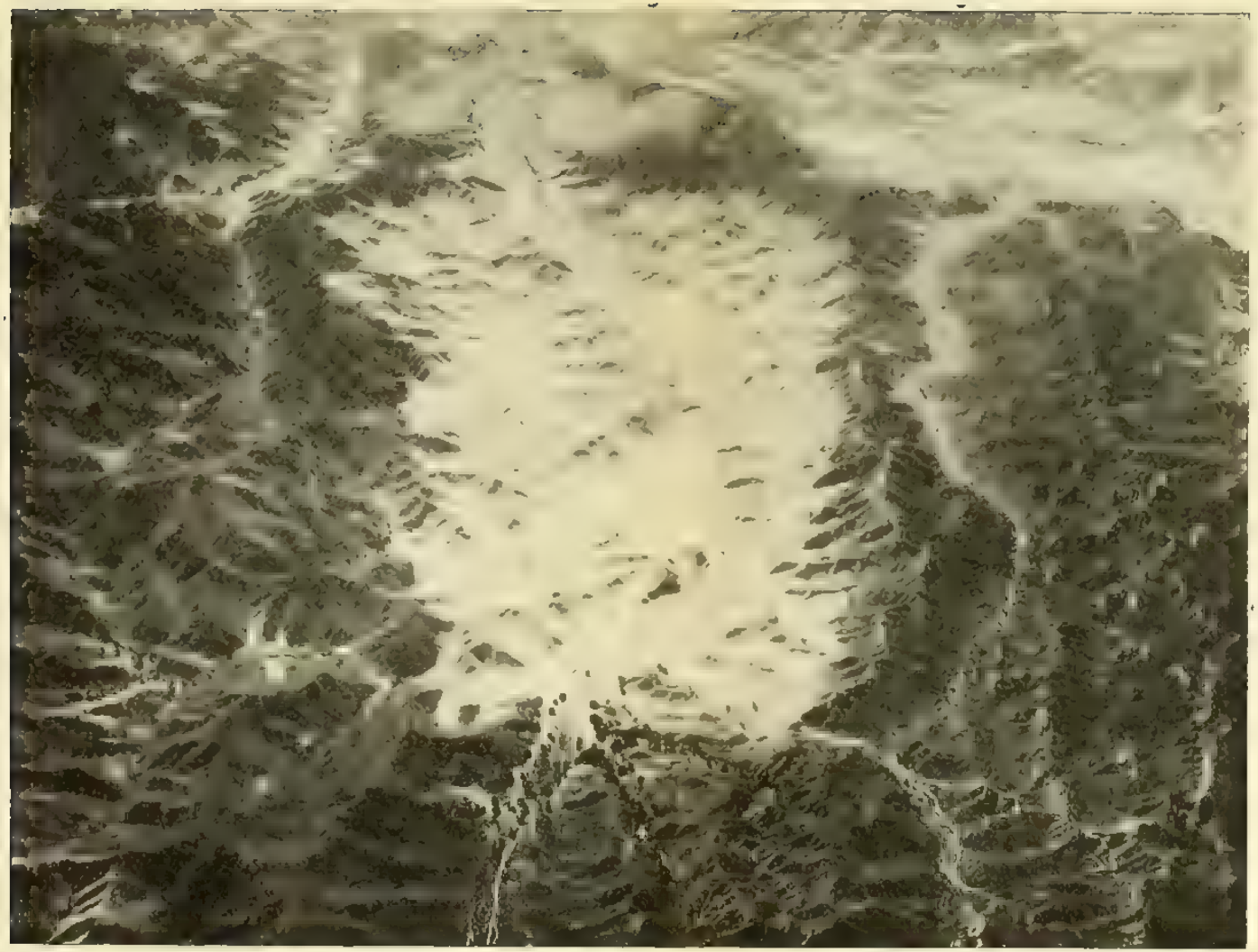

OBLIQUE VIEW RECORDS STRIKING STRUCTURE NEAR NEWHALL, CALIFORNIA

In studying aerial photographs it is essential that the pictures are right side up, or otherwise the tops of ridges become the bottoms of valleys, and vice versa. As an excellent illustration of this phenomenon turn the magazine over and then look at this picture.

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On the other hand it may be that the particular type of territory indicates that the main purpose of the pictures is to aid in tracing out bedding. In such a case the pictures should be taken as near noon time as possible so that the shadows will be minimized and the chances of bedding being lost in deep shadows on the photographs will be reduced. It is surprising to discover that frequently pictures of an identical area taken at two different times of year or even at different times of day can scarcely be identified as being the same subject.

Experience alone can dictate these matters, and it is for this reason that the aerial mapper and the geologist should work together in closest cooperation in order to insure satisfactory results. The use of air maps by geologists has become fairly well standardized. The material required for getting the maximum benefit out of the photographs usually consists of a set of contact prints made on matte paper so that the field geologist's notes can be made directly on the picture. A contact print is one made by direct contact at the same scale as the original negative. To aid in the interpretation of the contact prints it is usual for the geologist to have a stereoscope either in his office or a portable model in the field, or both. After the field work is completed the geological data are recorded on a great number of contact prints covering perhaps a large area. In order to correlate this information it is now standardized practice to have what is known as a matched mosaic. This consists of a careful assembly of the contact prints into a unitary picture. This picture is not necessarily corrected to be accurate to a high degree, but excepting in very precipitous country it is ordinarily sufficently accurate to enable the geologist to assemble and correlate his data, and to give him that continuity of observation which he gets from observing a large area at one look. Some geologists prefer to receive their mosaic maps in sheets of one township each, while other organizations prefer to have larger areas mosaicked into a single map.

Aside from the wealth of valuable information which the geologist gets from the aerial pictures—much of which he would perhaps not find at all without them, or at least not so quickly—he uses the aerial picture as a base map of superlative detail for the recording of his observation. From the standpoint of the geologist's requirement, the aerial map need not be supplemented by elaborate triangulation systems or nets of control. He no longer has to locate himself by Brunton compass observations. When he wishes to record an observation he plots it on his photograph at the intersection of two streams or beside a bush or beside a rock outcrop which he can identify. It is scarcely ever necessary for him to scramble to the top of a hill in order to tie himself in to a control system. However, it is still customary, in the intensively developed areas particularly, to put in an accurate ground control by conventional survey methods in order to be able to describe the areas which the company wishes to acquire and to tie them in for legal purposes.

Thus we find that the practice of many of the larger companies in putting in elaborate triangulation systems over extensive areas in which their geological parties are working is minimized by the use of aerial maps. After the geology has been completed the company may decide to buy or lease certain vital areas. It is usually time enough then to go in with survey parties and tie the geology which has been compiled from

the aerial maps to the ground for purposes of legal description. The putting in of triangulation systems often costs as much as or more than the total invested in aerial maps. If this work can be cut in half or even quartered by the use of the aerial maps, the major cost of the maps has been saved in one stroke and all of the many benefits derived may be considered as velvet.

The oil industry has found a great many applications for aerial maps outside of their geological use. They have been used successfully and quite extensively in pipe line location. Where time is a factor in the building of a pipe line the aerial map may accomplish in a few days what would take weeks on the ground. To be sure the final location will not be made from the aerial maps, as it is always necessary to actually stake out the projected construction work on the ground. However, it has frequently been found possible to make the location close enough with the aid of the aerial maps so that minor adjustments which have to be made can easily be done by the survey party which is making the final location in the field.

The maps have also been found very useful in road location. Not only are the photographic map and the stereoscope valuable for this purpose, but contour maps developed with the aid of the pictures have proven a rapid and economical means of gathering these data.

In a producing field the air map has been found a most convenient and satisfactory way of recording the details of construction. Taking the place or supplementing the ordinary 'utility' map, the aerial map, by giving 100 per cent detail on the ground, answered many questions in the engineering office without the necessity of going onto the ground to look. Also, for purposes of presenting construction problems to boards of directors and technical problems to juries, air maps have proven their utility.

There has been some discussion as to what is the most suitable scale for airplane pictures in conjunction with geological work. In this connection the author has had several occasions to compare pictures at a scale where 1 inch equals 2000 feet and where 1 inch equals 1000 feet. In most instances it has been found that practically everything of geological importance which shows at the 1000-foot scale also shows at the 2000-foot scale. The great advantage of the latter scale lies in the fact that in the first place it costs less per unit of area and in the second place it gives a great deal more area per contact print or per stereoscopic pair. This results in better continuity.

At a scale of 1000 feet to 1 inch an average airplane party can cover about 130 square miles per flying day; at a scale of 1500 feet to the inch the mileage is increased to about 200 square miles to 250 square miles; while at 1800 or 2000 feet to the inch it has been possible to map as much as 300 square miles and even more in one day. There is one record of 375 square miles having been mapped in a single flight at this scale. When time is an important factor in gathering this information it obviously is a great advantage to make the scale as small as possible because flying days are usually at a premium.

An interesting sidelight on the general situation of aerial mapping for geology is the fact that so much of the potential oil-bearing territory of California has already been mapped—that great sections of the territory are now available at so much per square mile just like

the aerial maps to the ground for purposes of legal description. The putting in of triangulation systems often costs as much as or more than the total invested in aerial maps. If this work can be cut in half or even quartered by the use of the aerial maps, the major cost of the maps has been saved in one stroke and all of the many benefits derived may be considered as velvet.

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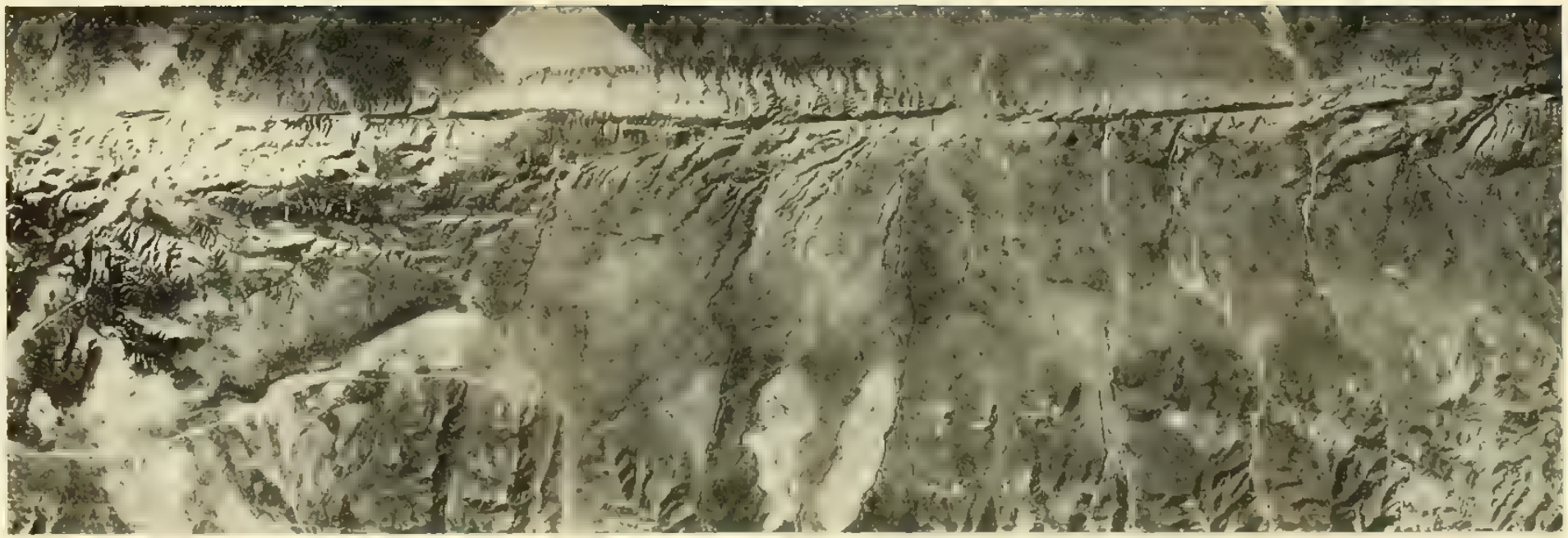

SECTION OF THE FAMOUS SAN ANDREAS FAULT WEST OF McKITTRICK, CALIFORNIA

This mosaic, made up of aerial photographs taken from a height of 17,000 feet, shows very graphically a large portion of this fault, considered to be one of the most remarkable examples of faulting in the world. It has been traced from San Francisco to the desert country near Banning, and is believed to extend on into Mexico, and out into the ocean above San Francisco. It is so easy to follow from the air that it is often used by aviators as a guide in flying from Southern California to San Francisco.

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any commodity which is sold over the counter. For instance, all of Los Angeles County has been mapped and is available in this way as well as many areas in the San Joaquin Valley and along the coast.

The aerial map has become the rule in most geological studies rather than the exception, and it is seldom indeed in this western territory that any major operators today will start on any geological problem without air maps to aid them.

ADMINISTRATIVE

WALTER W. BRADLEY, State Mineralogist

Personnel.

There have been no changes of personnel to be noted during the past three months.

New Publications.

During the quarterly period covered by this issue, the following publications of the Division have been made available for distribution:

Mining in California (quarterly) October, 1929, being Chapter 4 of State Mineralogist's Report XXV. Price 25 cents. The October issue contains reports on the Mineral Resources of Glenn, Alameda, Mendocino, and Riverside counties; also Index for the volume.

Summary of Operations, California Oil Fields, Vol. 14, Nos. 7 and 8, January and February, 1929, respectively, containing the following special articles: (January), "Santa Fe Springs Oil Field"; (February), "Resume of Oil Field Operations in California in 1928," "Production Statistics of California Oil Fields, July 1, 1928, to December 31, 1928," "Wildcat Wells Abandoned in 1928."

Mails and Files.

The Division of Mines maintains, in addition to its correspondence files and the library, a mine file which includes original reports on the various mines and mineral properties of all kinds in California.

During each quarterly period there are several thousand letters received and answered at the San Francisco office alone, covering almost every phase of prospecting, mining and developing mineral deposits, reduction problems, marketing of refined products, and mining law. In addition to this, hundreds of oral questions are answered daily, both at the main office and the district offices, for the many inquirers who come in for personal interviews and to consult the files and library.

MINERALS AND STATISTICS

Statistics, Museum, Laboratory

HENRY H. SYMONS, Statistician and Curator

STATISTICS

CALIFORNIA'S MINERAL PRODUCTION IN 1929

The total value of the mineral production of California for the year 1929, just closed, is conservatively estimated by the statistical division to have been $398,018,000. This is, in part, detailed in the tabulation below, but, as there are more than fifty mineral substances on California's commercial list, it is impracticable at this early date to obtain definite figures on other than the more important items. The blank report forms are being mailed to the operators in all mineral lines, and the detailed and complete report will be compiled and published later.

The estimated total of $398,018,000 is an increase of approximately $65,000,000 over the value of the 1928 production. The increase is due mainly to petroleum and in smaller measures to natural gas, copper and salines, although there were decreases in gold, cement, crushed rock and all other structural materials. There was an increase of approximately 60,000,000 barrels in quantity of crude oil, with the average value per barrel practically the same as for the year 1928. Around 85% of the crude oil at present produced in California is above 20° B., some testing as high as 60° B.; while the low grade ranges down to 9° B. Current prices range from 50¢ a barrel for 14°–20° crude in the San Joaquin Valley fields to $1.95 for 43° crude in the Athens-Rosecranz-Dominguez section. There was an increase in quantity of natural gas utilized.

Receipts of bullion at the mint and smelters show a decrease in the gold yield of about $2,500,000 compared with 1928, the drop being chargeable to both the lode mines and dredges. The drop in silver yield is due to the closing of silver mines in San Bernardino County and smaller shipments of lead ores. There were increased shipments of copper as well as an increase of about 2000 flasks of quicksilver.

The structural group showed about a 10% decrease throughout on account of lesser construction work during the year. Among the industrial and saline groups there were no notable changes reported, although the trend in the past has been a steady increase.

The estimated values and quantities for 1929 are as follows:

$8,393,000	gold.
569,000	(1,478,000 fine oz.) silver.
5,952,000	(33,255,000 lb.) copper.
81,000	(1,274,000 lb.) lead.
1,098,000	(9,000 flasks) quicksilver.
350,000	other metals, including iron, manganese, platinum, titanium, tungsten, zinc.
289,000,000	(291,900,000 bbl.) petroleum.
33,000,000	(370,000,000 M cu. ft.) natural gas.
22,000,000	(12,300,000 bbl.) cement.
16,000,000	crushed rock, sand and gravel.

$5,000,000	brick and hollow building tile.
475,000	(43,000 tons, crude) magnesite.
1,500,000	other structural materials, including granite, et al.
5,800,000	miscellaneous 'industrial' minerals.
8,800,000	salines, including borates, potash, salt, soda, et al.
$398,018,000	

MUSEUM

The Museum of the State Division of Mines possesses an exceptionally fine collection of rocks and minerals of both economic and academic value. It ranks among the first five of such collections in North America and contains not only specimens of most of the known minerals found in California, but much valuable and interesting material from other states and foreign countries as well.

In December of 1929 George E. Farish, Mrs. A. H. Collburn and Mrs. John S. Collburn presented their father's (the late John B. Farish, San Francisco mining engineer) mineral collection to the State Division of Mines. This collection consists of some 800 choice minerals from all over the world, some of which are extremely rare. Three exhibit cases have been allotted to the general collection, while the gold specimens will occupy a shelf in one of the gold safes.

Mr. Farish was a mining engineer of world-wide fame and did work on all the continents, which enabled him to obtain the best of minerals from many places, as his collection shows.

Mineral specimens suitable for exhibit purposes are solicited, and their donation will be appreciated by the State Division of Mines as well as by those who utilize facilities of the collection.

The exhibit is daily visited by engineers, students, business men, and prospectors, as well as tourists and mere sightseers. Beside its practical use in the economic development of California's mineral resources, the collection is a most valuable educational asset to the state and to San Francisco.

LABORATORY

FRANK SANBORN, Mineral Technologist

The question arising as to the important constituents of an unusual or interesting-looking rock and as to its possible commercial value is usually quickly answered for the prospector and those who are interested in the subject.

At the present time over fifty minerals of commercial value are mined in this state; therefore, it is important that prospectors take advantage of the laboratory service of the Division of Mines and have any rock identified that appears to be different from the ordinary country rock.

Ordinarily, a small sample weighing not over a pound is required in making a determination, but it should be in the unground, lump form if possible. When precious metals—gold, silver, platinum, etc.—are suspected, larger samples should be submitted. The size of the deposit is often of importance in determining the possible commercial value of a mineral, and when possible a statement regarding the extent of the orebody should be given. For instance, a good grade of gypsum would probably mean little if the deposit were small, but if the deposit were large and not far from transportation facilities it could very likely be commercialized.

LIBRARY

HERBERT A. FRANKE, Librarian

In addition to the numerous standard works, authoritative information on many phases of the mining and mineral industry is constantly being issued in the form of reports and bulletins by various government agencies.

The library of the Division of Mines contains some five thousand selected volumes on mines, mining and allied subjects, and it is also a repository for reports and bulletins of the technical departments of federal and state governments and of educational institutions, both domestic and foreign.

It is not the dearth of the latter publications, but rather a lack of knowledge of just what has been published and where the reports may be consulted or obtained, that embarrasses the ordinary person seeking specific information.

To assist in making the public acquainted with this valuable source of current technical information, MINING IN CALIFORNIA contains under this heading a list of all books and official reports and bulletins received, with names of publishers or issuing departments.

Files of all the leading technical journals will be found in the library, and county and state maps, topographical sheets and geological folios. Current copies of local newspapers published in the mining centers of the state are available for reference.

The library and reading room are open to the public during the usual office hours, when the librarian may be freely called upon for all necessary assistance.

OFFICIAL PUBLICATIONS RECEIVED

Governmental.

U. S. Geological Survey:

Professional Papers:

154-E Oil Shale in a Producing Oil Field in California. By H. W. Hoots.
158-C The Helderberg Group of Parts of West Virginia and Virginia. By F. McKim Swartz.
158-D Petrography of the Pioche District, Lincoln County, Nevada. By J. L. Gillson.
158-E The Varves and Climate of the Green River Epoch.
158-F Contact Metamorphism of the Rocks in the Pend Oreille District, Northern Idaho. By J. L. Gillson.
158-G Early Pleistocene Glaciation in Idaho.
158-H The Flora of the Frontier Formation. By E. W. Berry.
Fiftieth Annual Report of the Director of the Geological Survey, 1929.

Bulletins:

800 Geology and Mineral Deposits of Southeastern Alaska. By A. F. Buddington and T. Chapin.
810-B The Chandalar-Sheenjek District, Alaska. By J. B. Mertie, Jr.
811-D The Rawlins, Shirley and Seminoe Iron-Ore Deposits, Carbon County, Wyoming. By T. S. Lovering.
811-E Tertiary Volcanic Tuffs and Sandstones Used as Building Stones in the Upper Salmon River Valley, Idaho. By C. H. Behre, Jr.
812-A The Forsyth Coal Field, Montana. By C. E. Dobbin.

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812-B The Kevin-Sunburst Oil Field and Other Possibilities of Oil an Gas in the Sweetgrass Arch, Montana. By A. J. Collier.

Water Supply Papers:

578 The Mohave Desert Region, California. By D. G. Thompson.
598 Geology and Ground -Water Resources of North Dakota.
602 Surface Water Supply of the U. S., 1925.
603 Ohio River Basin.
604 St. Lawrence River Basin.
605 Hudson Bay and Upper Mississippi River Basins.
607 Lower Mississippi River Basin.
608 Western Gulf of Mexico Basins.
609 Colorado River Basin.
610 The Great Basin.
613 North Pacific Slope Drainage Basins.
614 North Pacific Slope Drainage Basins.
636-B Suspended Matter in the Colorado River in 1925–1928. By C. S Howard.

U. S. Bureau of Mines:

Technical Papers:

439 Geophysical Investigations at Caribou, Colo. By C. A. Heiland, C W. Henderson and J. A. Malkovsky.
453 Factors Governing Removal of Soluble Copper from Leached Ores By J. D. Sullivan and A. J. Sweet.
456 Classification and Tabling of Difficult Ores. By W. H. Coghill.
457 Centrifugal Concentration. By H. A. Doerner.
458 Accidents at Metallurgical Works in the U. S. 1927. By W. W Adams.
460 Design and Operation of Gas-Well Siphons. By I. B. Williams R. R. Brandenthaler and M. Walker.
462 Safety at Natural-Gasoline Plants. By G. B. Shea.
463 Depth Attainable by Electrical Methods in Applied Geophysics. B A. S. Eve, D. A. Keys and F. W. Lee.
464 Coal-Dust Explosibility Factors Indicated by Experimental Min Investigations, 1911 to 1929. By G. S. Rice and H. P. Green wald.
466 Effect of Manganese on Distribution of Carbon in Steel. By B. M Larsen.

Bulletins:

302 Fuel Efficiency Tests on Batch Oil Stills. By H. Kreisinger, W. R Argyle, and W. E. Rice.
309 Rock Bursts in the Lake Superior Copper Mines, Keweenaw Point Mich. By W. R. Crane.
310 Metal-Mine Accidents in the U. S., 1927. By W. W. Adams.
312 Bauxite. By B. W. Gandrud and F. D. De Vaney.
313 Permissible Storage-Battery Locomotives and Power Trucks. B L. C. Ilsley, E. J. Gleim, and H. B. Brunot.
314 Quarry Accidents in the U. S. 1927. By W. W. Adams.

Mineral Resources of the United States:

Arsenic, Bismuth, Selenium and Tellurium in 1928. By V. C. Heikes.
Copper in 1927. By C. E. Julihn and H. M. Meyer.
Slate in 1928. By O. Bowles and A. T. Coons.
Sulphur and Pyrites in 1928. By R. H. Ridgway.
Platinum and Allied Metals in 1928. By V. C. Heikes.
Clay in 1928. By J. Middleton.
Gold, Silver, Copper, Lead and Zinc in Montana in 1927. B. C. N. Gerry
Mercury in 1928. By P. M. Tyler.
Secondary Metals in 1928. By J. P. Dunlop.
Talc and Soapstone in 1928. By O. Bowles and B. H. Stoddard.
Gold, Silver, Copper, Lead and Zinc in California and Oregon in 1928. B V. C. Heikes.
Potash in 1928. By A. T. Coons.
Chromite in 1928. By L. A. Smith.

Asbestos in 1928. By O. Bowles and B. H. Stoddard.
Antimony in 1928. By P. M. Tyler.
Magnesium and Its Compounds in 1928. By P. M. Tyler.
Salt, Bromine, and Calcium Chloride in 1928. By A. T. Coons.
Iron Ore, Pig Iron and Steel in 1928. By H. W. Davis.
Gold, Silver, Copper, Lead and Zinc in the Eastern States in 1928. By J. P. Dunlop.
Graphite in 1928. By J. Middleton.
Feldspar in 1928. By O. Bowles and J. Middleton.
Recent Articles on Petroleum and Allied Substances. By M. Speer, September, 1929.
Recent Articles on Petroleum and Allied Substances. By M. Speer, October, 1929.
Recent Articles on Petroleum and Allied Substances. By M. Speer, November, 1929.
Miners' Circular 33—Advanced Mine Rescue Training. By J. J. Forbes and G. W. Grove.

Reports of Investigations:

2960—Temperatures for Rapid Self-Heating of Powdered Coal and the Semicoke Made Therefrom. By F. A. Hartgen and D. F. Smith.
2961—A Preliminary Investigation of Rubber-Sheathed, Parallel Duplex-Type Cables for Mining Machines. By L. C. Ilsley and A. B. Hooker.
2962—Official Changes in the Active List of Permissible Explosives and Blasting Devices for October, 1929.
(Supplements complete list published as Serial 2947, July, 1929.)
2963—Smelting in the Lead Blast Furnace. III—Rate of Descent of Stock Column and Formation of Accretions. By G. L. Oldright and Virgil Miller.
(The third of a series of papers on smelting in the lead blast furnace referred to under Serial 2954.)
2964—Survey of Fuel Consumption at Refineries in 1928. By G. R. Hopkins.
(Summarizes consumption of fuel oil, coal, natural gas, refinery gases, coke, and electricity as fuel at petroleum refineries in the United States, by regions.)
2965—Smelting in the Lead Blast Furnace. IV—Composition and Temperature of the Gases at the Tuyere Zone. By G. L. Oldright and Virgil Miller.
(The fourth paper of a series referred to under Serial 2954.
2966—Smelting in the Lead Blast Furnace. V—Effect of Conditions at Various Tuyeres on the Form of Lead and Composition of the Slag. By G. L. Oldright and Virgil Miller.
(The fifth of a series of reports intended to determine the conditions obtaining within the lead blast furnace by direct experimentation and to correlate behavior of furnace at various times with the main factors governing the operation of the blast furnace and controlling metallurgical losses.)
2967—The Dissolution of Cuprite in Sulphuric Acid and in Ferric Sulphate Solutions. By J. D. Sullivan and G. L. Oldright.
(Second of a series of papers on the dissolution of copper minerals in various agents.)
2969—The 1-3-Dimethyl-5-Phenoxyactic Acid and the 1-2-Dimethyl-3-Phenoxyactic Acid. By E. J. Schneider and J. B. Shohan.
2970—Reaction of Metallic Iron and Copper Sulphate in the Flotation of Sphalerite. By Fred D. DeVaney and C. W. Ambler, Jr.
(Describes flotation tests in which well-known reaction is applied to treatment of zinc ore.)
2971—A System of Accounts for the Slate Industry. By Oliver Bowles.
(A report of a study of accounting methods used by slate-quarry operators, presenting in detail a simple double-entry cost-accounting system designed for the general adoption of the slate industry.)
2972—Official Changes in the Active List of Permissible Explosives and Blasting Devices for November, 1929.

2973—Re-forming Natural Gas in Water-Gas Generators, with Substantially Complete Elimination of Entrained Carbon. By Wm. W. Odell.

2974—Abnormal Pressures in Explosion-Proof Compartments of Electrical Mining Machines. By E. J. Gleim.

(A discussion of typical examples of results obtained in tests of electrical equipment submitted for approval.)

2975—Dynamites: Their Propulsive Strength, Rate of Detonation, and Poisonous Gases Evolved. By N. A. Tolch and G. St. J. Perrott.

(Presents results of ballistic-pendulum, Bichel-gage, and other tests of straight, ammonia, and gelatin dynamites, black blasting powder, and kieselguhr. Describes types of explosives, discusses tests, and contains tabular data showing average chemical analyses of explosives, results of strength tests, comparative strength based on nitroglycerin content of equivalent straight dynamites, rate of detonation, and average analyses of products of detonation.)

2976—Permissible Explosives: A Study of Test Data. By G. St. J. Perrott and N. A. Tolch.

2978—Flow of Gas in Blast-Furnace Shaft. By S. P. Kinney.

2979—Odor Intensity and Symptoms Produced by Commercial Propane, Butane, Pentane, Hexane, and Heptane Vapor. By F. A. Patty and W. P. Yant.

(A study of the warning properties of fuel gas perceptible in advance of accumulations dangerous to health and safety.)

2980—Coke as a Domestic Heating Fuel. By P. Nicholls and B. A. Landry.

2981—Leaching Silver in Unroasted Tailings with Ferric Salts in Saturated Brine. By G. L. Oldright.

(Outlines the history of brine leaching and describes leaching tests on ores from Park City, Utah. Reports that 80 per cent of the silver and practically all of the lead present in an unroasted tailing were extracted by leaching for two hours with a warm brine solution containing ferric salt.)

Information Circulars:

6163—Gypsum: Its Uses and Preparation. By R. M. Santmyers.

(A summary of the history, mining methods, preparation, and uses of gypsum. States advantages of gypsum building materials.)

6171—Some Earth Resistivity Measurements. By F. W. Lee, J. W. Joyce, and Phil Boyer.

6173—Development of the Gypsum Industry by States. By R. M. Santmyers.

(A summary of production and sales of gypsum in the United States from the beginning of the industry to the present. Bibliography.)

6176—Effect of a Bonus on the Accident Record of the Southwestern Portland Cement Company. By Emory Smith.

6177—Colorado Mine Fatalities. By E. H. Denny, C. W. Owings, and D. Harrington.

6178—Mine Explosions in the United States During the Fiscal Year Ended June 30, 1929. By D. Harrington and C. W. Owings.

6179—Mining Soft Hematite at Mine No. 2 of the Marquette Range, Michigan. By Lucien Eaton.

6180—Mining Soft Hematite by Open Stopes at Mine No. 1, Menominee Range, Michigan. By Lucien Eaton.

6181—Mining Laws of the Federated Malay States. By John W. Frey.

6182—Mining Laws of Mexico. By P. M. Linebarger.

6183—Mining Laws of Yugoslavia. By P. M. Tyler.

6184—Mining Laws of Guatemala. By A. D. Garman.

6185—Mining Laws of New Zealand. By J. W. Frey.

6186—Mining Methods and Costs, Alaska Juneau Gold Mining Company, Juneau, Alaska. By P. R. Bradley.

6188—Mining Laws of Turkey. By John W. Frey.

6189—Electrical Blasting in Sinking Montreal No. 5 Shaft; also Some Safety Practices at the Montreal Mine. By F. S. Crawford and C. W. Owings.

6190—Beryllium and Beryl. By Alice V. Petar.
(Summarizes literature on the properties, uses, history, and occurrences of beryllium and beryl. Gives bibliography on beryllium.)
6191—Accident Reduction in Alabama Coal Mines. By F. E. Chas.
6192—Mining Laws of Persia. By John W. Frey.
6193—Mining Ore in Open Stopes, Central and Eastern United States. By Chas. F. Jackson.
(A progress report for first half of 1929 on the study of mining methods and costs in the Eastern and Central States; summarizes data on mining methods and costs from twenty mines using open-stope methods.)
6194—Safety as Affected by Supervision and Discipline. By A. W. Miller.
(Emphasizes the need of intensive supervision and strict enforcement of safety rules in the mining industry.)
6195—Notes on Precautions to Be Taken When Drilling Oil or Gas Wells Through Workable Coal Beds or Through Mine Workings. By C. A. Herbert.
6196—Physiological Factors of Mine Ventilation. By R. R. Sayers.
6197—Mining Laws of Portugal. By John W. Frey.
6198—Reccommendations of the Bureau of Mines on Certain Questions of Mine Safety as of August, 1929.
6199—Mining Laws of Portuguese Possessions. By John W. Frey.
6200—Method and Cost of Mining the Pittsburgh, or No. 8, Coal Beds in a 100 Per Cent Mechanized Mine in Eastern Ohio. By W. F. Hazen and E. U. Christy.
6201—Hazards from Low or Under Voltage. By L. C. Ilsley.
6202—Distillation-Amalgamation Methods for the Determination of Mercury in Ores. By C. W. Davis.
6203—Geophysical Abstracts No. 6. By F. W. Lee.
6204—Survey of Fuel-Oil Distribution, Central United States, 1928. By A. T. Coumbe, Jr.
6205—Mica. Part I, General Information. By W. M. Myers.
6206—Industrial Gas Masks Abroad. By S. H. Katz.
6207—Mining Laws of Paraguay. By A. D. Garman.
6208—Method and Cost of Mining the Pittsburgh, or No. 8, Coal Bed in Four Eastern Ohio Mines. By J. W. Paul and H. Tomlinson.
6209—Geophysical Abstracts No. 7.
6210—Mining Laws of Venezuela. By A. D. Garman.
6211—Methods of Some Progressive Mining Companies in Placing Responsibility for Mine Accidents. By D. Harrington, C. W. Owings, and F. E. Cash.
6212—Present-Day Knowledge of the Chemical Constitution of Coal. By J. B. Shohan.
6213—Mining Laws of Rumania. By E. P. Youngman.
6214—Mining Laws of Honduras. By A. D. Garman.
6216—Mining Laws of Peru. By A. D. Garman.
6218—Electrical Motored Equipment: Approvals and Extensions. By L. C. Ilsley and M. W. Means.
6220—State Regulations Governing the Use of Trolley Wires in Mines. By L. C. Ilsley and R. A. Kearns.
6224—Geophysical Abstracts No. 8. By F. W. Lee.

U. S. Bureau of Foreign and Domestic Commerce:

Monthly Summary of Foreign Commerce of the U. S.:

Part 1, September, 1929.
Part 2, September, 1929.
Part 1, October, 1929.
Part 2, October, 1929.
Part 1, November, 1929.

U. S. Coast and Geodetic Survey:

Supplement to Inside Route Pilot, New York to Key West.
Earthquake Investigation in the U. S. By N. H. Heck.
Annual Report of the Director, U. S. Coast and Geodetic Survey, June 30, 1929.
Special Publication No. 140—Manual of First-Order Leveling. By H.G. Avers.

U. S. Commission of Gold and Silver Inquiry:

Serial 6—Field Hearings. By Fletcher Hamilton.
Serial 8—Foreign Currency and Exchange Investigation Foreign Exchange Quotations and Curves. By H. N. Lawrie.
Serial 9—European Currency and Finance. By J. P. Young.

U. S. Department of Agriculture:

Bureau of Soils:

1916—Anaheim Area (parts of Los Angeles, Orange and San Bernardino counties).
1920—Big Valley Area (parts of Modoc and Lassen counties).
1924—Bishop Area (parts of Inyo and Mono counties).
1920—Brawley Area (part of Imperial County).
1923—Coachella Valley Area (part of Riverside County).
1921—Eureka Area (part of Humboldt County).
1923—Gilroy Area (part of Santa Clara County).
1918—Grass Valley Area (part of Nevada County).
1901—Hanford Area (parts of Fresno and Kings counties).
1915—Healdsburg Area (part of Sonoma County).
1923—Hollister Area (part of San Benito County).
1915—Honey Lake Area (part of Lassen County).
1901—Imperial Area (part of Imperial County).
1903—Indio Area (part of Riverside County).
1922—Lancaster Area (parts of Kern and Los Angeles counties).
1901—Lower Salinas Valley (part of Monterey County).
1914—Merced Area (part of Merced County).
1922—Palo Verde Area (parts of Riverside and Imperial counties).
1915—Pasadena Area (parts of Los Angeles and San Bernardino counties).
1915—Riverside Area (parts of Riverside and San Bernardino counties).
1915—San Fernando Valley Area (part of Los Angeles County).
1901—San Gabriel Area (parts of Los Angeles and San Bernardino counties).
1903—San Jose Area (parts of Alameda and Santa Clara counties).
1916—Santa Maria Area (parts of San Luis Obispo and Santa Barbara counties).
1919—Shasta Valley Area (part of Siskiyou County).
1914—Ukiah Area (part of Mendocino County).
1917—Ventura Area (parts of Los Angeles and Ventura counties).
1901—Ventura Area (part of Ventura County).
1921—Victorville Area (part of San Bernardino County).
1918—Willits Area (part of Mendocino County).

Reconnaisance:

1917—Central-Southern (parts of Los Angeles, Orange, Riverside, San Bernardino and San Diego counties).
1916—Middle San Joaquin Valley Area (parts of Fresno, Kings and Tulare counties).

U. S. Treasury Department:

Document No. 3012—Annual Report of the Director of the Mint, June 30, 1929.

U. S. War Department:

Annual Report of the Chief of Engineers.
U. S. Army, 1929, Vols. 1 and 2.

Arizona State Mine Inspector:

Seventeenth Annual Report of the State Mine Inspector, November 3, 1928.
Mining Code of the State of Arizona. By T. C. Foster.

California Department of Public Works:

Division of Water Resources:

Bulletin No. 18—California Irrigation.
District Laws, 1929 Revision.

California Fish and Game:

Vol. 15, No. 4, October, 1929.

California State Library:

News Notes, Vol. 24, No. 4, October, 1929.

California State Department of Public Works:

California Highways and Public Works, December, 1929.

Colorado School of Mines:

Geophysical News and Review of Geophysical Literature. By J. A. Malkovsky and D. Wantland.

Colorado Scientific Society Proceedings:

Vol. 12—Revision of Structure and Stratigraphy in the Mosquito Range and the Leadville District, Colorado. By C. H. Behre.

Connecticut State Geological and Natural History Survey:

Bull. 45—Thirteenth Biennial Report of the Geological and Natural History Survey of Connecticut.

Bull. 46—The Physical History of the Connecticut Shoreline. By H. S. Sharp.

Illinois State Geological Survey:

Press Bull. No. 18, Nov. 2, 1929.

Nevada State Bureau of Mines and Mackay School of Mines:

Vol. 1, No. 1—Mineral Resources of Southern Nevada.

New York State Museum Bulletin:

No. 283, November, 1929—The Gypsum Resources and Gypsum Industry of New York. By D. H. Newland.

Oklahoma Geological Survey:

Bull. 50—Structure of the Ouachita Mountains of Oklahoma and Arkansas. By H. D. Miser.

Bull. 51—A Chemical Study of Oklahoma Coals. By J. E. Moose and V. C. Searle.

Circular 19—Accelerated Weathering Properties of Oklahoma Asphalts. By P. G. Shelley.

Circular 20—Native Road Materials and Highway Maintenance. By N. E. Wolfard.

State Geological Survey of Kansas:

Bull. 12—The Geology of Cowley County, Kansas. By N. W. Bass.

Texas University Bureau of Economic Geology:

Bulletins:

1818—The Geology of Dallas County. By E. W. Shuler.

1821—Fossil Ice Crystals. By J. A. Udden.

1856—The Weno and Pawpaw Formations of the Texas Comanchean. By W. S. Adkins.

On a New Ammonite Fauna of the Lower Turonian of Mexico. By E. Rose.

2229—The Geology of Johnson County. By W. M. Winton and G. Scott.

2239—The Producing Horizon in the Rios Well in Caldwell County. By E. H. Sellards.

2330—The Geology of Potter County. By L. T. Patton.

2333—The Geology and Natural Resources of Colorado County. By T. L. Bailey.

2340—Geology and Mineral Resources of McLennan County. By W. S. Adkins.

2346—Report on the Oil and Gas Possibilities of the University Block 46 in Culberson County. By J. W. Beede.

2433—Species of the Genus Schwagerina and their Stratigraphic Significance. By J. W. Beede and H. T. Kniker.

2509—Etched Potholes. By J. A. Udden.

2539—The Lytton Springs Oil Field. By H. P. Bybee and R. T. Short.

2544—The Geology of Denton County. By W. M. Winton.

2607—The San Angelo Formation and the Geology of Foard County. By J. W. Beede and D. D. Christner.

2609—The Southwest Earthquake of July 30, 1925. By J. A. Udden.
2612—Foraminifers of the Cretaceous of Central Texas. By D. O. Carsey.
2644—The Foraminifers of the Midway Formation. By H. J. Plummer.
2645—The Gueydan, a New Middle Tertiary Formation from the Southwestern Coastal Plain of Texas. By T. L. Bailey.
363—The Deep Boring at Spur. By J. A. Udden.
2703—Some Microscopic Characteristics of the Bend and Ellenburger Limestones. By J. A. Udden and V. V. Waite.
2710—The Geology of Cooke County. By H. P. Bybee and F. M. Bullard, and Petroleum Developments in Cooke County. By E. M. Hawtof.
2738—Geology and Mineral Resources of the Fort Stockton Quadrangle. By W. S. Adkins.
2744—Igneous Rocks of the Balcones Fault Region of Texas. By J. T. Lonsdale.
2745—Exploratory Geology of a Part of Southwestern Trans-Pecos Texas. By C. L. Baker.
2748—The Cretaceous of the Rio Grande Valley and Northern Mexico. By E. Bose and O. A. Cavins.
Ammonites from the Cretaceous of Texas and Northern Mexico. By E. Bose.
2801—Contributions to Geology.
2807—Geology of Tom Green County. By G. G. Henderson.
2838—Handbook of Texas Cretaceous Fossils. By W. S. Adkins.

West Virginia Geological Survey:

Pocahontas County Report. By P. H. Price and D. B. Reger.

Wyoming Geological Survey:

Fourteenth Biennial Report of the State Geologist.

Argentina Ministerio de Agricultura de la Nacîon,
Direccion General de Minas, Geologia e Hidrologia:

Publication Nos. 57, 58, 59, 60, 61, 62, 63, 64, 65 and 66.

Canada Department of Mines:

No. 697—Investigations in Ceramics and Road Materials, 1927.
No. 696—Investigations of Fuels and Fuel Testing, 1927.

Geological Survey:

Memoir 159—Bear River and Stewart Map-areas, Cassiar District, B. C. By G. Hanson.
Memoir 157—Preliminary Report on Woman River and Ridout Map-areas, Sudbury District, Onario. By R. C. Emmons, and E. Thomson.

National Museum of Canada:

Bull. 56—Annual Report for 1927.

Finland Geological Commission:

Bull. No. 87, June, 1929.

Great Britain Geological Survey:

Summary of Progress for the Year 1928, Part 2.

Bulletins du Comite Geologique, Leningrad, Russia:

Vol. 48, No. 4, 1929.
Vol. 48, No. 3, 1929.
Livraison 138, No. 8.
Livraison 126, No. 6.

South Australia Department of Mines:

No. 50—Mining Review.

Secretaria de Industria, Comercio y Trabajo, Mexico:

Departmento de Minas:

Tomo 28, Numero 3.

Societies and Educational Institutions.

American Association of Petroleum Geologists:

Vol. 13, No. 11, November, 1929.
Vol. 13, No. 12, December, 1929.
Vol. 14, No. 1, January, 1930.

American Geographical Society:

The Geographical Review, Vol. 19, 1929.
The Geographical Review, January, 1930.

American Institute of Mining and Metallurgical Engineers:

Transactions, 1929 Year Book.

American Manganese Producers Association:

Proceedings of the Second Annual Convention.

American Philosophical Society:

Vol. 68, No. 3, 1929.

Australian Museum:

Vol. 17, No. 4—Mollusca from the Continental Shelf of Eastern Australia, No. 2. By T. Iredale.
Vol. 17, No. 5—Bees in the Australian Museum Collection. By T. D. A. Cockerell.

Canadian Institute of Mining and Metallurgy:

Bulletins:

211.
212.
213.

Botanical Institution of the University of Freiburg:

29th Volume.

Buffalo Society of Natural Sciences:

Vol. 6, Nos. 2, 3, 4—The Paleontology of Eighteen Mile Creek and the Lake Shore Sections of Erie County, New York. By A. W. Grabau.
Vol. 7, No. 1—Guide to the Geology and Paleontology of Niagara Falls and Vicinity. By A. W. Grabau.
Vol. 12—Catalogue of the Fossil Fishes in the Museum of the Buffalo Society of Natural Sciences. By L. Hussakof and W. L. Bryant.
Vol. 14, No. 2—The Dresbach Formation of Minnesota. By E. Peterson.

Bulletins du Comite Geologique, Leningrad:

Livraison 94.
Livraison 131.
Vol. 48, No. 5.
Vol. 48, No. 6.
Livraison 134.
Livraison 137.
Livraison 139.

Economic Geology:

Vol. 1, Nos. 1 and 2, July, 1929—Annotated Bibliography of Economic Geology for 1928.
Vol. 24, No. 7, November, 1929.
Vol. 24, No. 8, December, 1929.

Engineers' Society of Western Pennsylvania:

Vol. 45, No. 8, November, 1929.

Field Museum of Natural History:

Geology Leaflet 8—Agate, Physical Properties and Origin. By O. C. Farrington.
Geology Leaflet 11—Neanderthal Man. By O. C. Farrington and H. Field.
Geology Leaflet 12—Cement. By H. W. Nichols.
Archaeology and Folklore. By B. Laufer.

Industrial Accident Commission of California:

Mine Safety Orders, Effective January 1, 1921.

Institution of Mining and Metallurgy:

Bulletin No. 302, November, 1929.
Bulletin No. 303, December, 1929.
Bulletin No. 304, January, 1930.

Institution of Petroleum Technologists, London:

Recent Advances in Our Knowledge of Natural Gas and "Cracking" Gas and Their Industrial Utilisation. By H. M. Stanley.

Journal of Geology:

Vol. 35, No. 7—Fault Troughs. By S. Taber.
Vol. 37, No. 3—The Relation of Chemical Composition to Texture of Groundmass in Siliceous Lavas. By H. A. Powers.

Library of Congress:

Monthly Check List of State Publications:

Vol. 20, Nos. 7–8.
Vol. 20, No. 9.
Report of the Librarian of Congress, June 30, 1929.

Library of the Far Eastern State University, Vladivostok, U. S. S. R.:

Series 3, No. 8.
Series 3A.
Series 7, No. 11.
Series 11, No. 1.
Series 11, No. 2.
Series 12, No. 1.
Series 12, No. 3.
Series 13, No. 4.

Mineralogical Society of America Journal:

Vol. 14, No. 11, November, 1929.
Vol. 14, No. 12, December, 1929.
Vol. 15, No. 1, January, 1930.

Mining and Metallurgical Society of America:

Bull. 206, Vol. 22, No. 9.
Bull. 207, Vol. 22, No. 10.

Museo de Historia Natural de Montevideo:

Serie 2, Tomo 3, Entrega 1. Anales.

Museu Nacional, Rio de Janeiro:

Vol. 5, Nos. 1, 2, 3.

National Research Council of Canada:

Vol. 1, No. 4, October, 1929.
Vol. 1, No. 5, November, 1929.
Vol. 1, No. 6, December, 1929.

Philippine Journal of Science:

Vol. 40, No. 3, November, 1929.
Vol. 40, No. 4, December, 1929.
Vol. 41, No. 1, January, 1930.

Ryojun College of Engineering:

Vol. II, No. 3.
Vol. II, No. 4-A.
Vol. II, No. 4-B.
Vol. III, No. 1.

San Diego Society of Natural History:

Vol. 5, No. 19—A New Pacific Race of Gull-Billed Tern. By G. Bancroft.
Vol. 5, No. 20—Fossil Diatoms Dredged From Bering Sea. By G. D. Hanna.

Smithsonian Institution:

Vol. 76, Art. 16—Colites or Cave Pearls in the Carlsbad Caverns. By F. L. Hess.
Annual Report, 1928. Publication 2981.

Society of Chemical Industry, London:

The Production of Gaseous, Liquid, and Solid Hydrocarbons from Methane. Part 2—The Action of Spark Discharge on Methane. By H. M. Stanley and A. W. Nash.

South Australia Royal Society:

Volume LII.

University of Arizona Bureau of Mines:

Bull. 10—Gold Placers of Arizona. By F. G. McClure.
Bull. 23—Bibliography of Arizona Mining Metallurgy and Geology. By E. Luttrell.

University of California:

Vol. 18, No. 14—The Ione Formation of California. By V. T. Allen.
Vol. 18, No. 15—A New Cetothere from Southern California. By R. Kellogg.
Vol. 19, No. 1—The Passerine Remains from Rancho La Brea in the Paleontological Collections of the University of California. By A. H. Miller.

University of Nevada:

Vol. 22, No. 1—A Table for the Identification of Nevada's Common Minerals. By O. R. Grawe.
Vol. 22, No. 2—Dumortierite.

University of Oregon:

Vol. 1, No. 3—The Jurassic and Cretaceous Rudistids of Oregon. By R. L. Lupher and E. L. Packard.

Western Society of Engineers:

Vol. 34, No. 11, November, 1929.
Vol. 34, No. 12, December, 1929.

Books.

Anomalies of Vertical Intensity Compared with Regional Geology for the State of California. By G. B. Somers.

Maps.

West Virginia:

Pocahontas County Maps.

Montana:

Central and Eastern Montana Geologic Map.

U. S. G. S. Topographic Maps:

California:

Tulare County—Sausalito School Quadrangle.
Tulare County—Delano Quadrangle.
Tulare and Kern Counties—Quincy School Quadrangle.
Tulare, Kings and Kern Counties—Hacienda Ranch Quadrangle.
Tulare and Kern Counties—Stone Quadrangle.
Tulare and Kern Counties—Richgrove Quadrangle.
Kings County—Stratford Quadrangle.

Current Magazines on File.

For the convenience of persons wishing to consult the technical magazines in the reading room, a list of those on file is appended:

Architect and Engineer, San Francisco.
Asbestos, Philadelphia, Pa.

Asbestology, Canadian Asbestos Co., Montreal.
American Trust Review of the Pacific, San Francisco.
Bessemer Monthly, Grove City, Pa.
Brick and Clay Record, Chicago.
Caterpillar, San Leandro, Cal.
Chemical Engineering and Mining Review, Melbourne, Australia.
Colorado School of Mines, Golden, Colo.
Commerce Reports, Washington, D. C.
Engineering Graphic, Chicago.
Engineering and Mining Journal, New York City.
Explosive Service Bulletins, Wilmington, Del.
Fusion Facts, Whittier, Cal.
Graphite, Jersey City.
Grizzly Bear, Los Angeles.
Hercules Mixer, Wilmington, Del.
Ingenieria, Mexico, D. F.
Lubrication, The Texas Co., New York City.
Mining Congress Journal, Washington, D. C.
Mining and Industrial Record, Vancouver, B. C.
Mining Journal, Phoenix, Arizona.
Mining and Metallurgy, New York City.
Mining Review, Salt Lake City.
Mining Truth, Spokane, Wash.
National Sand and Gravel, Washington, D. C.
Nation's Business, Washington, D. C.
Oil Bulletin, Los Angeles.
Oil Field Engineering, Philadelphia, Pa.
Oil and Gas Journal, Tulsa, Oklahoma.
Oil, Paint and Drug Reporter, New York City.
Oil Trade, New York City.
Oil Weekly, Houston, Texas.
Pit and Quarry, Chicago.
Pacific Purchaser, San Francisco.
Petroleum Age, Chicago.
Petroleum Times, London, E. C. 2.
Petroleum World and Oil Age, Los Angeles.
Queensland Government Mining Journal, Brisbane, Australia.
Record, Associated Oil Co., San Francisco.
Rocks and Minerals, Peekskill, N. Y.
Rock Products, Chicago.
Scientific American, New York City.
Southwest Builder and Contractor, Los Angeles.
Standard Oil Bulletin, San Francisco.
Stone, New York City.
Through the Ages, Baltimore.

Newspapers.

The following papers are received and kept on file in the library:

Amador Dispatch, Jackson, California.
Barstow Printer, Barstow, California.
Beaumont Gazette, Beaumont, California.
Bridgeport Chronicle-Union, Bridgeport, California.
California Oil World, Los Angeles, California.
Colusa Daily Sun, Colusa, California.
Daily Commercial News, San Francisco, California.
Daily Midway Driller, Taft, California.
Del Norte Triplicate, Crescent City, California.
Denver Mining Record, Denver, Colorado.
Exeter Sun, Exeter, California.
Goldfield News, Goldfield, Nevada.
Inyo Independent, Independence, California.
Inyo Register, Bishop, California.
Ione Valley Echo, Ione, California.
Mariposa Gazette, Mariposa, California.

Mercury Register, Oroville, California.
Mojave Miner, Kingman, Arizona.
Morning Union, Grass Valley, California.
Mountain Messenger, Downieville, California.
Nevada City Nugget, Nevada City, California.
Nevada Mining Press, Reno, Nevada.
Oil Refinery News, Bayonne, New Jersey.
Petroleum Press, Taft, California.
Placer Herald, Auburn, California.
Plumas Independent, Quincy, California.
San Diego News, San Diego, California.
Shasta Courier, Redding, California.
Siskiyou News, Yreka, California.
Sotoyome Scimitar, Healdsburg, California.
Stockton Record, Stockton, California.
Tuolumne Prospector, Tuolumne, California.
Waterford News, Waterford, California.
Weekly Trinity Journal, Weaverville, California.
Western Sentinel, Etna Mills, California.

PRODUCERS AND CONSUMERS

The producer and consumer of mineral products are mutually dependent upon each other for their prosperity, and one of the most direct aids rendered by the Bureau to the mining industry in the past has been that of bringing producers and consumers into direct touch with each other.

This work has been carried on largely by correspondence, supplemented by personal consultation. Lists of buyers of all the commercial minerals produced in California have been made available to producers upon request, and likewise the owners of undeveloped deposits of various minerals, and producers of them, have been made known to those looking for raw mineral products.

When the publication of MINING IN CALIFORNIA was on a monthly basis, current inquiries from buyers and sellers were summarized and lists of mineral products or deposits 'wanted' or 'for sale' included in each issue.

It is important that inquiries of this nature reach the mining public as soon as possible and in order to avoid the delay incident to the present quarterly publication of MINING IN CALIFORNIA, these lists are now issued monthly in the form of a mimeographed sheet under the title of 'Commercial Mineral Notes,' and sent to those on the mailing list for MINING IN CALIFORNIA.

EMPLOYMENT SERVICE

Following the establishment of the Mining Division branch offices in 1919, a free technical employment service was offered as a mutual aid to mine operators and technical men for the general benefit of the mineral industry.

Briefly summarized, men desiring positions are registered, the cards containing an outline of the applicant's qualifications, position wanted, salary desired, etc., and as notices of 'positions open' are received, the names and addresses of all applicants deemed qualified are sent to the prospective employer for direct negotiations.

Telephone and telegraphic communications are also given immediate attention.

Technical men, or those qualified for supervisory positions, and vacancies of like nature only, are registered, as no attempt will be made to supply common mine and mill labor.

Registration cards for the use of both prospective employers and employees may be obtained upon request, and a cordial invitation is extended to the industry to make free use of the facilities afforded. Parties interested should communicate direct with our San Francisco office.

PUBLICATIONS OF THE DIVISION OF MINES

During the past fifty years, in carrying out the provisions of the organic act creating the former California State Mining Bureau, there have been published many reports, bulletins and maps which go to make up a library of detailed information on the mineral industry of the state, a large part of which could not be duplicated from any other source.

One feature that has added to the popularity of the publications is that many of them have been distributed without cost to the public, and even the more elaborate ones have been sold at a price which barely covers the cost of printing.

Owing to the fact that funds for the advancing of the work of this department have often been limited, many of the reports and bulletins mentioned were printed in limited editions which are now entirely exhausted.

Copies of such publications are available, however, in the office of the Division of Mines, in the Ferry Building, San Francisco; New Orpheum Building, Los Angeles; State Office Building, Sacramento; Redding; Santa Maria; Santa Paula; Coalinga; Taft; Bakersfield. They may also be found in many public, private and technical libraries in California and other states, and foreign countries.

A catalog of all publications from 1880 to 1917, giving a synopsis of their contents, is issued as Bulletin No. 77.

Publications in stock may be obtained by addressing any of the above offices and enclosing the requisite amount in the case of publications that have a list price. Only coin, stamps or money orders should be sent, and it will be appreciated if remittance is made in this manner rather than by personal check.

The prices noted include delivery charges to all parts of the United States. Money orders should be made payable to the Division of Mines.

NOTE.—The Division of Mines frequently receives requests for some of the early reports and bulletins now out of print, and it will be appreciated if parties having such publications and wishing to dispose of them will advise this office.

REPORTS

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**First Annual Report of the State Mineralogist, 1880, 43 pp. Henry G. Hanks	----
**Second Annual Report of the State Mineralogist, 1882, 514 pp., 4 illustrations, 1 map. Henry G. Hanks	----
**Third Annual Report of the State Mineralogist, 1883, 111 pp., 21 illustrations. Henry G. Hanks	----
**Fourth Annual Report of the State Mineralogist, 1884, 410 pp., 7 illustrations. Henry G. Hanks	----
**Fifth Annual Report of the State Mineralogist, 1885, 234 pp., 15 illustrations, 1 geological map. Henry G. Hanks	----
**Sixth Annual Report of the State Mineralogist, Part I, 1886, 145 pp., 3 illustrations, 1 map. Henry G. Hanks	----
**Part II, 1887, 222 pp., 36 illustrations. William Irelan, Jr.	----
**Seventh Annual Report of the State Mineralogist, 1887, 315 pp. William Irelan, Jr.	----
**Eighth Annual Report of the State Mineralogist, 1888, 948 pp., 122 illustrations. William Irelan, Jr.	----

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**Ninth Annual Report of the State Mineralogist, 1889, 352 pp., 57 illustrations, 2 maps. William Irelan, Jr.	----
**Tenth Annual Report of the State Mineralogist, 1890, 983 pp., 179 illustrations, 10 maps. William Irelan, Jr.	----
Eleventh Report (First Biennial) of the State Mineralogist, for the two years ending September 15, 1892, 612 pp., 73 illustrations, 4 maps. William Irelan, Jr.	$1.00
**Twelfth Report (Second Biennial) of the State Mineralogist, for the two years ending September 15, 1894, 541 pp., 101 illustrations, 5 maps. J. J. Crawford	----
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**Mines and Mineral Resources of Imperial and San Diego Counties, 113 pp., paper	----
**Mines and Mineral Resources, Shasta, Siskiyou and Trinity Counties, 180 pp., paper	----
**Fourteenth Report of the State Mineralogist, for the Biennial Period 1913–1914, Fletcher Hamilton, 1915:	
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Chapters of the State Mineralogist's Report, Biennial Period, 1915–1916. Fletcher Hamilton:	
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Eighteenth Report of the State Mineralogist, 1922, 'Mining in California,' Fletcher Hamilton. Chapters published monthly beginning with January, 1922:	
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Chapters of Nineteenth Report of the State Mineralogist, 'Mining in California,' Fletcher Hamilton and Lloyd L. Root. January, February, March, September, 1923	Free

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Chapters of Twentieth Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly. January, April, **July, October, 1924, per copy	$0.25
Chapters of Twenty-first Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly:	
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Chapters of Twenty-second Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly:	
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Bulletin No. 102. California Mineral Production for 1928, by Henry H. Symons. 1929, 210 pp., paper	Free

PRELIMINARY REPORTS

**Preliminary Report No. 1. Notes on Damage by Water in California Oil Fields, December, 1913. By R. P. McLaughlin. 4 pp.	----
**Preliminary Report No. 2. Notes on Damage by Water in California Oil Fields, March, 1914. By R. P. McLaughlin. 4 pp.	----
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**Preliminary Report No. 8. A Review of Mining in California During 1921, with Notes on the Outlook for 1922. By Fletcher Hamilton, 1922. 68 pp. Paper	----

MISCELLANEOUS PUBLICATIONS

**First Annual Catalogue of the State Museum of California, being the collection made by the State Mining Bureau during the year ending April 16, 1881. 350 pp.	----
**Catalogue of books, maps, lithographs, photographs, etc., in the library of the State Mining Bureau at San Francisco, May 15, 1884. 19 pp.	----
**Catalogue of the State Museum of California, Volume II, being the collection made by the State Mining Bureau from April 16, 1881, to May 5, 1884. 220 pp.	----
**Catalogue of the State Museum of California, Volume III, being the collection made by the State Mining Bureau from May 15, 1884, to March 31, 1887. 195 pp.	----
**Catalogue of the State Museum of California, Volume IV, being the collection made by the State Mining Bureau from March 30, 1887, to August 20, 1890. 261 pp.	----
**Catalogue of the Library of the California State Mining Bureau, September 1, 1892. 149 pp.	----
**Catalogue of West North American and Many Foreign Shells with Their Geographical Ranges, by J. G. Cooper. Printed for the State Mining Bureau, April, 1894	----
**Report of the Board of Trustees for the four years ending September, 1900. 15 pp. Paper.	----
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**Register of Mines, with Map, Tuolumne County	----
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OTHER MAPS

**Map of California, Showing Mineral Deposits (50 x 60 in.)	----
**Map of Forest Reserves in California	----
**Mineral and Relief Map of California	----
**Map of El Dorado County, Showing Boundaries, National Forests	----
**Map of Madera County, Showing Boundaries, National Forests	----
**Map of Placer County, Showing Boundaries, National Forests	----
**Map of Shasta County, Showing Boundaries, National Forests	----
**Map of Sierra County, Showing Boundaries, National Forests	----
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Geological Map of Inyo County. Scale 1 inch equals 4 miles	.60
**Map of California accompanying Bulletin No. 89, showing generalized classification of land with regard to oil possibilities. Map only, without Bulletin	----
Geological Map of California, 1916. Scale 1 inch equals 12 miles. As accurate and up-to-date as available data will permit as regards topography and geography. Shows railroads, highways, post offices and other towns. First geological map that his been available since 1892, and shows geology of entire state as no other map does. Geological details lithographed in 23 colors. Unmounted	.75
Mounted	2.00
Topographic Map of Sierra Nevada Gold Belt, showing distribution of auriferous gravels, accompanying Bulletin No. 92 (also sold singly) In 4 colors	.50

OIL FIELD MAPS

Asterisks (**) indicate the publication is out of print.

These maps are revised from time to time as development work advances and ownerships change.

		Price
Map No. 1	—Sargent, Santa Clara County	.50
Map No. 2	—Santa Maria, including Cat Canyon and Los Alamos	.75
Map No. 3	—Santa Maria, including Casmalia and Lompoc	.75
Map No. 4	—Whittier-Fullerton, including Olinda, Brea Canyon, Puente Hills, East Coyote and Richfield	.75
Map No. 5	—Whittier-Fullerton, including Whittier, West Coyote and Montebello	.75
Map No. 6	—Salt Lake, Los Angeles County	.75
Map No. 7	—Sunset and San Emidio and Kern County	.75
Map No. 8	—South Midway and Buena Vista Hills, Kern County	.75
Map No. 9	—North Midway and McKittrick, Kern County	.75
Map No. 10	—Belridge and McKittrick, Kern County	.75
Map No. 11	—Lost Hills and North Belridge, Kern County	.75
Map No. 12	—Devils Den, Kern County	.75
Map No. 13	—Kern River, Kern County	.75
Map No. 14	—Coalinga, Fresno County	1.00
Map No. 15	—Elk Hills, Kern County	.75
Map No. 16	—Ventura-Ojai, Ventura County	.75
Map No. 17	—Santa Paula-Sespe Oil Fields, Ventura County	.75
Map No. 18	—Piru-Simi-Newhall Oil Fields	.75
Map No. 19	—Arroyo Grande, San Luis Obispo County	.75
Map No. 20	—Long Beach Oil Field	1.25
Map No. 21	—Portion of District 4, Showing Boundaries of Oil Fields, Kern and Kings counties	.75
Map No. 21A	—Portion Kern and Kings counties	.75
Map No. 22	—Portion of District 3, Showing Oil Fields, Santa Barbara County	.75
Map No. 23	—Portion of District 2, Showing Boundaries of Oil Fields, Ventura County	.75
Map No. 24	—Portion of District 1, Showing Boundaries of Oil Fields, Los Angeles and Orange counties	.75
Map No. 26	—Huntington Beach Oil Field	.75
Map No. 27	—Santa Fe Springs Oil Field	.75
Map No. 28	—Torrance, Los Angeles County	.75
Map No. 29	—Dominguez, Los Angeles County	.75
Map No. 30	—Rosecrans, Los Angeles County	.75
Map No. 31	—Inglewood, Los Angeles County	.75
Map No. 32	—Seal Beach, Los Angeles and Orange counties	.75
Map No. 33	—Rincon, Ventura County	.75
Map No. 34	—Mt. Poso, Kern County	.75
Map No. 35	—Round Mountain, Kern County	.75
Map No. 36	—Kettleman Hills, Kings County	1.25
Map No. 37	—Montebello, Los Angeles County	.75
Map No. 38	—Whittier, Los Angeles County	.75
Map No. 39	—West Coyote, Los Angeles and Orange counties	.75
Map No. 40	—Elwood, Santa Barbara County	.75

DETERMINATION OF MINERAL SAMPLES

Samples (limited to three at one time) of any mineral found in the state may be sent to the Division of Mines and Mining for identification, and the same will be classified free of charge. No samples will be determined if received from points outside the state. It must be understood that no assays, or quantitative determinations will be made. Samples should be in lump form if possible, and marked plainly with name of sender on outside of package, etc. No samples will be received unless delivery charges are prepaid. A letter should accompany sample, giving locality where mineral was found and the nature of the information desired.

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STATE OF CALIFORNIA

DEPARTMENT OF NATURAL RESOURCES

DIVISION OF MINES

CORDIALLY INVITES YOU TO VISIT
ITS VARIOUS DEPARTMENTS MAINTAINED
FOR THE PURPOSE OF FURTHERING
THE DEVELOPMENT OF THE

MINERAL RESOURCES OF CALIFORNIA

At the service of the public are the scientific reference library and reading room, the general information bureau, the laboratory for the free determination of mineral samples found in the state, and the largest museum of mineral specimens on the Pacific Coast. The time and attention of the state mineralogist, as well as that of his technical staff, are also at your disposal.

Office hours: 9 a.m. to 5 p.m. daily
Saturday, 9 a.m. to 12 m.

Walter W. Bradley,
State Mineralogist.

Third floor, Ferry Building, San Francisco, Cal.

Branch Offices: New Orpheum Building, Los Angeles; State Office Building, Sacramento; Chamber of Commerce, Redding; Bank of Italy Building, Bakersfield; Taft, Coalinga, Santa Maria and Santa Paula.

Mining in California

APRIL, 1930

PUBLISHED QUARTERLY

STATE OF CALIFORNIA
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF MINES

FERRY BUILDING
SAN FRANCISCO

DIVISION OF MINES

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STATE OF CALIFORNIA
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF MINES
FERRY BUILDING, SAN FRANCISCO

WALTER W. BRADLEY — State Mineralogist

Vol. 26 — APRIL, 1930 — No. 2

CHAPTER OF

REPORT XXVI OF THE STATE MINERALOGIST

COVERING

ACTIVITIES OF THE DIVISION OF MINES

INCLUDING THE

GEOLOGIC BRANCH

CALIFORNIA STATE PRINTING OFFICE
SACRAMENTO, 1930

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PREFACE

The Division of Mines (formerly State Mining Bureau) is maintained for the purpose of assisting in all possible ways in the development of California's mineral resources.

As one means of offering tangible service to the mining public, the State Mineralogist for many years has issued an annual or a biennial report reviewing in detail the mines and mineral deposits of the various counties.

The weak point in work of this character has been that the results of field investigations were so long in preparation that they had lost much of their usefulness by the time they finally appeared in print.

As a progressive step in advancing the interests of the mineral industry, publication of the Annual Report of the State Mineralogist in the form of monthly chapters was begun in January, 1922, and continued until March, 1923.

Owing to a lack of funds for printing this was changed to quarterly publication, beginning in September, 1923.

For the same reason, beginning with the January, 1924, issue, it has been necessary to charge a subscription price of $1 per calendar year, payable in advance; single copies, 25 cents apiece. 'Mining in California' will continue to be sent without charge to our exchange list, including schools and public libraries, as are also other publications of the Division of Mines.

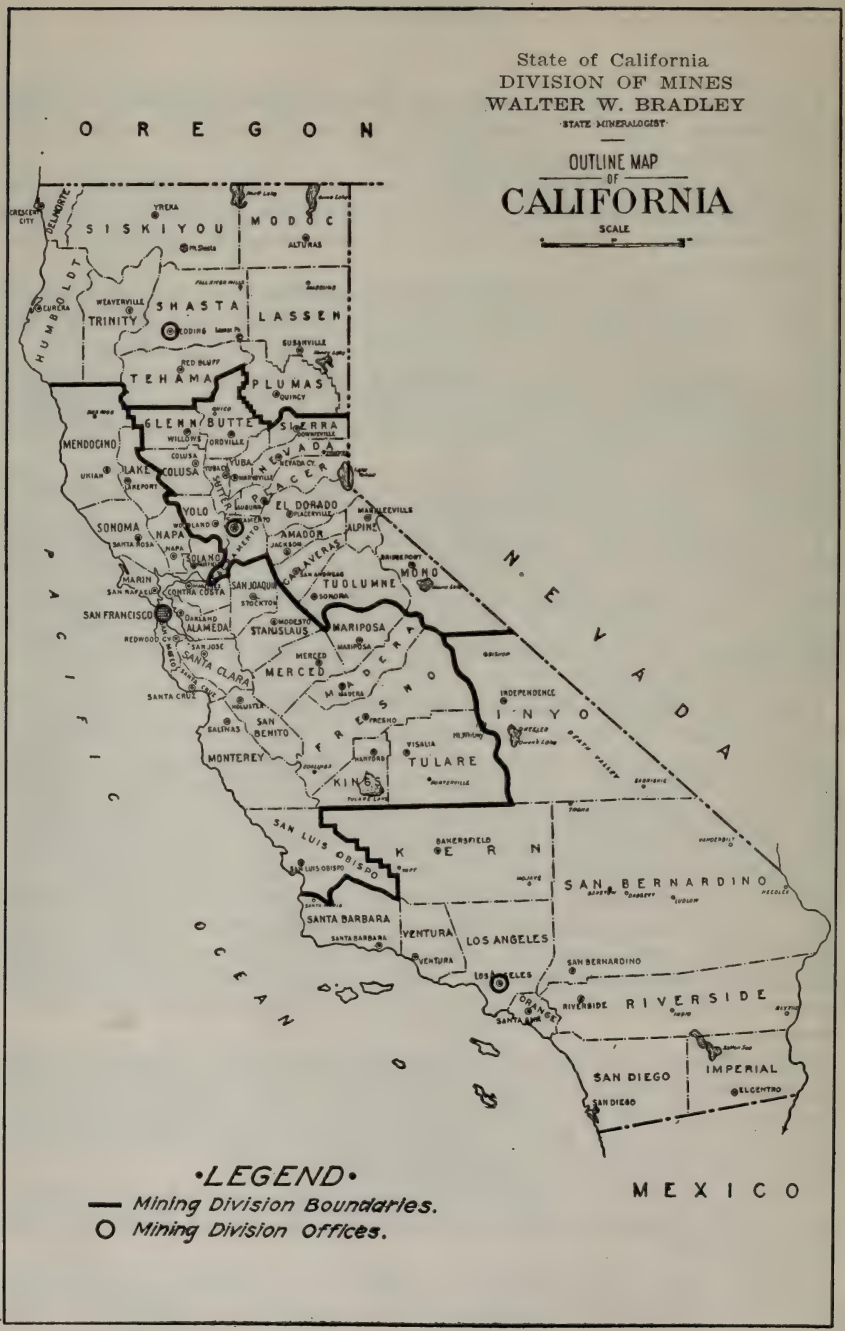
Pages are numbered consecutively throughout the year and an index to the complete reports is included annually in the closing number.

Such a publication admits of several improvements over the old method of procedure. Each issue contains a report of the current development and mining activities of the state, prepared by the district mining engineers. Special articles dealing with various phases of mining and allied subjects by members of the staff and other contributors are included. Mineral production reports formerly issued only as an annual statistical bulletin are published herein as soon as returns from producers are compiled. The executive activities, and those of the laboratory, museum, library, employment service and other features with which the public has had too little acquaintance also are reported.

While current activities of all descriptions will be covered in these chapters, the practice of issuing from time to time technical reports on special subjects will be continued, as well. A list of such reports now available is appended hereto, and the names of new bulletins will be added in the future as they are completed.

The chapters will be subject to revision, correction and improvement. Constructive suggestions from the mining public will be gladly received, and are invited.

The one aim of the Division of Mines is to increase its usefulness and to stimulate the intelligent development of the wonderful, latent resources of the State of California.


State of California
DIVISION OF MINES
WALTER W. BRADLEY
STATE MINERALOGIST
OUTLINE MAP
OF
CALIFORNIA
SCALE
OREGON
NEVADA
PACIFIC OCEAN
MEXICO
SISKIYOU
MODOC
TRINITY
SHASTA
LASSEN
TEHAMA
PLUMAS
GLENN
BUTTE
SIERRA
NEVADA
MENDOCINO
LAKE
COLUSA
YUBA
EL DORADO
YOLO
SONOMA
NAPA
SOLANO
AMADOR
ALPINE
MARIN
CONTRA COSTA
SAN JOAQUIN
TUOLUMNE
MONO
SAN FRANCISCO
ALAMEDA
STANISLAUS
MARIPOSA
SANTA CLARA
MERCED
SAN BENITO
MONTEREY
INYO
FRESNO
TULARE
KINGS
SAN LUIS OBISPO
KERN
SAN BERNARDINO
SANTA BARBARA
VENTURA
LOS ANGELES
RIVERSIDE
ORANGE
SAN DIEGO
IMPERIAL
•LEGEND•
Mining Division Boundaries.
Mining Division Offices.

DISTRICT REPORTS OF MINING ENGINEERS

In 1919–1920 the Mining Bureau was organized into four main geographical divisions, with the field work delegated to a mining engineer in each district, working out from field offices that were established in Redding, Auburn, San Francisco and Los Angeles, respectively. This move brought the office into closer personal contact with operators, and it has many advantages over former methods of conducting field work. In 1923 the Redding and Auburn field offices were consolidated and moved to Sacramento.

The Redding office was reestablished in 1928, and the boundaries of each district adjusted. The counties now included in each of the four divisions, and the locations of the branch offices, are shown on the accompanying outline map of the state. (Frontispiece.)

Reports of mining activities and development in each division, prepared by the district engineer, will continue to appear under the proper field division heading.

Although the petroleum industry is but little affiliated with other branches of mining, oil and gas are among the most valuable mineral products of California, and a report by the State Oil and Gas Supervisor on the current development and general conditions in the state's oil fields is included under this heading.

New County Reports.

The series of separate reports on the mines and mineral resources of the different counties, that together comprise the State Mineralogist's Reports XIV to XVII, inclusive, in the case of many of the counties have become exhausted. Those still in stock being in need of revision, it was deemed advisable, beginning with the January, 1925, issue of 'Mining in California,' to make the district engineers' reports in the form of a complete general report on the mines and mineral resources in one or more of the counties in each district.

This program has been followed as nearly as possible in succeeding numbers of the quarterly.

REDDING FIELD DIVISION

CHAS. VOLNEY AVERILL, Mining Engineer

There is no report from the Redding Field Division, as Mr. Chas. V. Averill, District Mining Engineer in charge, is engaged on geological field work.

SACRAMENTO FIELD DIVISION

C. A. Logan, Mining Engineer

NEVADA COUNTY

Geography.

The county extends from the foothills bordering the east side of Sacramento Valley, to the summits of the Sierra Nevada on the eastern state line. Known primarily as a mining county, Nevada has a variety of climate shared by the other counties to the south, and a similar diversity of industries. In the western foothill belt where the winters are mild with no snow, and where the dry season extends from May to November, fruit and live stock are raised. The principal towns, Grass Valley and Nevada City, have always been supported chiefly by mining. Both these districts lie at elevations of about 2500 feet. They are reached by a paved lateral of the state highway system branching from the Lincoln highway at Auburn. Grass Valley is 60 miles by highway from Sacramento, and Nevada City 64 miles. The two cities have railroad connection with the Southern Pacific at Colfax by way of the Nevada County Narrow Gauge Railroad. Automobile bus lines also give service.

All the other mining districts in the eastern part of the county, except Meadow Lake, are tributary to Nevada City (the county seat) and Grass Valley, as are also nearby parts of Sierra County. Automobile bus lines run with few interruptions to Washington (18 miles), to Alleghany, Sierra County, and intervening points, and to North Bloomfield. Meadow Lake district, in the high mountains nine miles north of Cisco on the Southern Pacific, is reached from there or from Truckee, 30 miles away by road, and is practically the only district which is sure to be shut off by snow each winter.

Water, Power and Timber.

The mountain lakes and the heavy snowfall in the eastern section of the county, once utilized only by the hydraulic miner who built storage reservoirs and long and expensive canals to lead water to the mammoth gravel deposits, have in later years been put to work for irrigation and power purposes. Many of the old miners' canals have been put back in commission, and their log dams have been replaced by larger and more substantial ones. The centralization of water rights in the hands of an irrigation district and a power company has been going on apace. Bowman, Meadow, Fordyce and Spaulding are the larger lakes used to store water for irrigation and power. It is becoming increasingly hard for the mine operator to get free water for an independent power supply or for placer mining. The supply for quartz milling is usually adequate in all parts of the county. Electric power, in use many years in the Grass Valley and Nevada City districts, was provided commercially in the Washington district only this year. Pine timber suitable for mine use is abundant above 2500 feet elevation.

Mineral Resources.

The county has produced a variety of mineral products but has been preeminent for its gold mines, both quartz and placer. The deep

gold quartz mines of Grass Valley have been the most productive and longest-lived in the state, so far as individual mines go, and although surpassed in amount of annual output during the peak years of gold dredging by both Yuba and Butte County, Nevada County has far exceeded the other gold mining counties in total production since 1880.

Asbestos, barytes, chromite, copper, lead, mineral paint, pyrites and tungsten concentrate have also been produced commercially. Silver is produced entirely as a by-product, naturally alloyed with gold. Small tonnages of manganese ore and granite have been marketed. Platinum group metals occur in small quantity in some of the placer mines. Miscellaneous stone, including sand and gravel, is utilized locally in considerable quantity for road work and paving.

ANTIMONY

Two prospects of antimony sulphide (stibnite) were mentioned in the report, 'Mines and Mineral Resources of Nevada County' published in 1918. One is in the SW¼ Sec. 25, T. 15 N., R. 8 E., 7½ miles south of Grass Valley near Wolf Creek, the other at Moore's Flat 21 miles northeast of Nevada City. Neither one proved commercial.

ASBESTOS

Sierra Asbestos Company, 715 Easton Bldg., Oakland. E. R. Leach, president. The property and operations of this company were described in the 1918 and 1920 reports. Little has been done since on account of litigation. This property is 2½ miles by road northwest of Washington and 21 miles from Nevada City. It was a producer between 1917 and 1923 when small tonnages of ore were milled. The product was short-fiber chrysotile asbestos obtained by milling serpentine carrying a network of asbestos veinlets. Only a little of the asbestos was an inch or more in length. Mining was by open pit and the original milling plant was a 20-stamp mill fitted with air suction and fiberizing machinery. Later 42-inch rolls were installed, giving a capacity of 250 tons a day.

BARYTES

Democrat Barytes Mine. Owner, Chemical and Pigments Company, Incorporated, 766 Fiftieth avenue, Oakland. In Sec. 24, T. 16 N., R. 10 E., seven miles by road from Dutch Flat. Elevation, 3450 feet.

The outcrop of the deposit, which has been mostly removed by mining, was in the shape of a dome or knob on the point of a steep ridge overlooking Bear River. Of irregular shape, it varied in width from 15 to 24 feet at the surface and had a length of 250 feet, rising about 60 feet above the level of an old ditch at the highest point of outcrop.

The ore of commercial grade (showing in part as much as 98% $BaSO_4$) passes into an impure barium-aluminum silicate rock on the north, and on the hanging wall side there is no regular contact between ore and rock. The barytes varies in color from pink or grey to black, and is nearly all slightly 'off-color' when ground, requiring chemical treatment.

The deposit was first worked in 1919 by Bear Barytes Company. In 1920, Metals and Chemicals Extraction Company took the property

MINERAL PRODUCTION OF

Year	Copper		Gold, value	Granite	
	Pounds	Value		Cubic feet	Value
1880			$2,702,362		
1881			3,700,000		
1882			3,500,000		
1883			3,000,000		
1884			2,950,000		
1885			2,577,873		
1886			3,221,038		
1887			2,719,574		
1888			2,600,000		
1889			2,249,335		
1890			1,969,613		
1891			2,207,886		
1892			1,945,406		
1893			2,067,203		
1894	83,728	$7,535	1,830,155		
1895	33,255	3,325	1,789,816		
1896	28,200	2,820	2,380,756		
1897			1,885,251	1,100	$2,200
1898	30,000	3,000	2,017,628	2,000	1,500
1899	43,438	7,084	2,171,510	2,000	1,500
1900	150,980	20,472	1,812,036		
1901	39,588	6,235	2,121,054		
1902	26,500	3,975	2,142,740	1,000	3,000
1903	4,500	585	2,458,047	2,170	4,160
1904			3,130,304	2,335	5,395
1905			3,179,715	2,155	2,570
1906			2,658,420	9,525	9,300
1907	22,082	4,418	2,162,083	12,840	9,300
1908	30,166	4,104	2,297,963	700	2,100
1909			2,660,235	1,250	2,800
1910			2,533,483	2,225	3,215
1911	1,665	209	2,199,147	1,250	3,500
1912			2,081,958		
1913			2,918,733		
1914	39	5	3,301,948		
1915	1,817	318	3,466,722		
1916	3,487	858	3,669,878	100	100
1917	40,165	10,965	3,682,947		
1918	42,203	10,424	3,070,453		
1919	[2]		2,981,312	[2]	
1920	[2]		2,872,471	[2]	
1921			2,570,162	[2]	
1922	[2]		2,903,573	[2]	
1923	[2]		2,282,155	[2]	
1924	[2]		2,820,032	[2]	
1925	[2]		2,305,607	[2]	
1926	[2]		2,318,846	[2]	
1927	[2]		2,127,195	[2]	
1928	[2]		1,994,002	[2]	
Totals	[3]581,813	$86,332	$126,208,627	[3]40,650	$50,640

[1]Includes crushed rock, rubble, sand, gravel.
[2]See under 'Unapportioned.'

NEVADA COUNTY, 1880-1923

Lead		Silver, value	Miscellaneous stone[1], value	Miscellaneous and unapportioned		
Pounds	Value			Amount, (tons)	Value	Substance
		$70,144				
		9,500				
		10,000				
		8,000				
		5,000				
		4,835				
		8,333				
		2,477				
		5,000				
		5,633				
		14,713				
		14,184				
		8,326				
		1,229				
		476		290	$5,800	Mineral paint.
		400		150	2,250	Mineral paint.
		8,584				
		8,116				
		19,476		50	1,000	Mineral paint.
				6,000	30,000	Pyrite.
		17,784		300	5,400	Mineral paint.
				5,400	28,620	Pyrite.
		66,841		2,925	17,550	Pyrite.
		18,122		78	429	Pyrite.
		6,124				
		3,252				
		9,555				
		32,523			20	Platinum.
		24,219				
		17,505				
663	$25	21,914	$1,678			
		24,926	1,874		400,000	Unapportioned, 1900-1909.
		16,506				
14,831	667	15,691				
1,785	80	22,830				
2,090	92	26,542	5,000			
145	6	27,000	2,108		60	Gems.
1,567	74	23,762	3,675		1,950	Other minerals.
1,036	71	35,741	1,225	981	12,795	Chromite.
					23,475	Manganese, platinum, tungsten.
[2]		52,335	1,600	1,962	43,449	Chromite.
					47,101	Asbestos, lead, platinum, tungsten concentrates.
[2]		72,557	1,400	3,328	116,993	Chromite.
					29,884	Asbestos, lead, manganese, platinum, tungsten concentrates.
[2]		68,731	1,976		12,034	Asbestos, barytes, chromite, copper, granite, lead, platinum.
[2]		58,476	6,528		17,531	Asbestos, barytes, copper, granite, lead.
		33,906	19,151		17,862	Asbestos, barytes, granite.
[2]		19,583	27,982		14,867	Barytes, copper, granite, lead, mineral paint.
1,290	90	30,534	42,309		15,682	Asbestos, barytes, copper, granite, mineral paint, platinum.
[2]		39,252	82,200		3,783	Copper, granite, lead.
[2]		32,155	10,333		4,782	Chromite, copper, granite, lead.
4,301	344	30,015	850,000		41,006	Barytes, copper, granite.
[2]		27,581	15,000		43,933	
[2]		20,798	4,000		5,086	Copper, granite, lead.
27,768	$1,449	$1,101,186	$1,078,039		$943,382	

and operated for three years. In 1926, the present owners began work, operating in 1926 and 1927 and again the present season. The property during the past ten years, except during 1928, has been the largest producer of barytes in the state. When visited (August 28, 1929) eleven men were employed and production was at the rate of 100 to 150 tons daily.

Mining for several seasons was by open-cut. Later a crosscut called 100-ft. level was run into the hill. At present, ore is mined through a series of five raises put up from the 30-ft. level into the bottom of the old open-cut. Ore from this level is dropped down a main raise to 100-ft. level and trammed thence to the loading bin at the tram terminal. The ore has been mined for 250 feet in length on the surface and the 30-ft. level is about 200 feet long. No advance development has been done yet.

The working season is about five months. Mining equipment includes a 4-drill compressor, operated by a gas engine, air drills, mine cars and blacksmith shop. For transporting ore across the steep canyon of Bear River there is a gravity tram 1800 feet long with a bucket carrying two tons. From the tram terminal ore is hauled to the railroad at Alta, about six miles distant, in 5-ton trucks, for shipment to the Oakland plant.

Spanish Barytes Deposit. Spanish Mining Company and San Francisco Commercial Company, owners, c/o F. W. Bradley, Crocker Building, San Francisco. It is in the NW¼ Sec. 19, T. 18 N., R. 11 E., five miles by road west of Graniteville.

The outcrop of the deposit is on the line of the old North Bloomfield ditch, at an elevation of 4600 feet. When first visited by the writer in 1919, the outcrop was examined for a length of 330 feet. The color of the freshly broken rock is white to creamy white, and the quality as shown at the outcrop appeared to be good throughout; but the joints and bedding planes at the surface are coated with bright red layers of iron oxide, sometimes over one-eighth inch in thickness. No work had been done on the deposit at that time, but it was so promising that only the distance from railroad prevented its development and utilization.

Since that time, prospecting done by the owners has developed a deposit which is claimed to contain several hundred thousand tons of barite. A crosscut run at a depth 280 feet vertically below the deposit (aneroid measurement) either bottomed it or indicated it had been cut off by a fault. Of this possible faulting, however, there was no evidence when the workings were visited. No barite showed at this level where the country rock is Carboniferous slate and schist. The barite was prospected by a raise 400 feet long on the dip to the surface, which is reported to show barite all the way, in places 15 feet thick and up to seven feet wide on the surface. Stripping has shown the deposit to extend considerably farther than indicated by the outcrop. It strikes north. No commercial shipments have been made. Considerable prospecting for other ores has been done on the claims near the barite deposit.

Nevada City is 27 miles distant via the North Bloomfield road and 24 miles by way of Washington. This connection, however, would be

with the narrow gauge railroad, requiring more expense for transfer to broad gauge cars, at Colfax. The truck haul from the deposit tc the Tahoe-Ukiah highway (which connects with Emigrant Gap on the broad gauge railroad as well as with Nevada City) would involve a descent of 1800 feet vertically to Washington, then a climb of 1500 feet in vertical distance in four miles, with another climb from Bear Valley to Emigrant Gap, which is 20 miles from the deposit.

CHROMITE

Over 6000 tons of this ore and concentrate was produced in the county from 1916 to 1919. The deposits were described in the report for 1918 and in Bulletin 76, 'Manganese and Chromium in California.' Many of the deposits contained low-grade ore and two stamp mills at Nevada City were utilized for crushing this ore for concentration. The grade of concentrate made on Johnson, Deister and Union concentrators was low, running in most cases from 32% to 36% Cr_2O_3. The grade obtainable was limited by the high iron oxide content of the ore.

The larger producers were properties near the Champion Mine, just outside Nevada City, which supplied ores for the mills mentioned, and the *Red Ledge Mine*, near Washington, where ore carrying 42% to 45% Cr_2O_3 was produced.

COPPER

There is no production of copper ores now in Nevada County. The principal output in the past has been in the vicinity of Spenceville, close to the western county line, 17 to 20 miles by road from the railroad at Wheatland. Here copper and iron sulphide ore, with pyrite predominating, occurs at several mines at and near the contact of granodiorite and diabase. The *Spenceville Copper Mine* was the largest producer. Work began there in 1875 and was continued for 13 years by *San Francisco Copper Company* who produced about 150,000 tons of ore which is said to have averaged 5% copper. The ore was roasted in heaps which were leached and copper was precipitated on scrap iron and marketed as cement copper. In 1887 the price of copper fell and work ceased. In 1890, *Imperial Paint and Copper Company* put up a furnace and paint mill and made red paint from the old dumps of roasted ore. In 1897, *Spence Mineral Company* unwatered and reopened the old workings (which had caved in 1882) and produced a large amount of pyrite ore which was shipped to the bay district and used in the manufacture of sulphuric acid. The cinder contained 3% to 3½% copper and a little gold and silver. Most of the ore came from between the surface and the 150-ft. level, and although the last company planned some work below the 150-ft. level, the amount done is not known. The last production here was between 1916 and 1918 when the water was pumped from the old workings and some cement copper was precipitated.

The mines adjacent to Little Dry Creek, 2½ miles north of Spenceville, have all lain idle in late years. Some of them produced ore which could be hauled 20 miles to the railroad and sold at a profit when copper was at 'boom' prices, but can not be handled at present. There are also numerous prospects and small mines in other

parts of the county on which little or no work has been done lately. These have been mostly prospects where work has not been carried far enough to result in production. They have been described in Bulletin 50 and in the last report on 'Mines and Mineral Resources of Nevada County,' 1918. The price of copper since the war has not encouraged operation of such Californian copper prospects which would be high-cost producers, many of which are 15 miles or more from the railroad.

In the later years of operation of the Champion Mine near Nevada City, some copper and lead were produced from rock mined primarily for gold. Other such ores have also yielded copper.

GARNET

Brown garnet occurs in the region about 10 miles southwest of Grass Valley near Clear Creek. There has been nothing but the most superficial prospecting done on the outcrops which appear on ranches owned by *C. H. Elster* in Sec. 30, T. 15 N., R. 8 E. and by *W. B. Smith* about 3 miles from Elster's place.

GOLD (QUARTZ MINES)

Summary.

Since 1880 the gold mines of Nevada County have produced a recorded total of $126,208,627 to the end of 1928. Most of this came from the quartz mines. For the first time since 1900, the output in 1928 was less than $2,000,000. Strangely enough, the 'war years' from 1914 to 1918, inclusive, marked a high tide of production, each of these years showing an output of over $3,000,000, the total being greater than for any like period since 1880. Nearly two-thirds of the gold mined in the county since 1880 has come from mines either operated by or subsequently acquired by Empire Mines and Investment Company and North Star Mines Company, both lately consolidated under an operating company called Empire-Star Mines, controlled by Newmont Mining Corporation. Of the remainder, nearly one-half came from mines now controlled by Idaho-Maryland Consolidated Mines, Incorporated. These two consolidations control most of the mines and mineral rights in the Grass Valley district proper, in or near the town of Grass Valley.

The principal operations in Nevada City district in later years were at the Champion-Providence group, owned by North Star Mines Company. Recently, the Murchie mine there has been reopened and it is hoped that it may become an important producer. Other attempts of small or inadequately financed companies to open paying mines in these two districts during the past 12 years have been largely abortive.

In the Washington and Graniteville districts there have been several efforts in the past few years to rejuvenate former producing properties. At present one well financed company is carrying on prospecting and development which may bring in a new mine near Washington.

Grass Valley District.

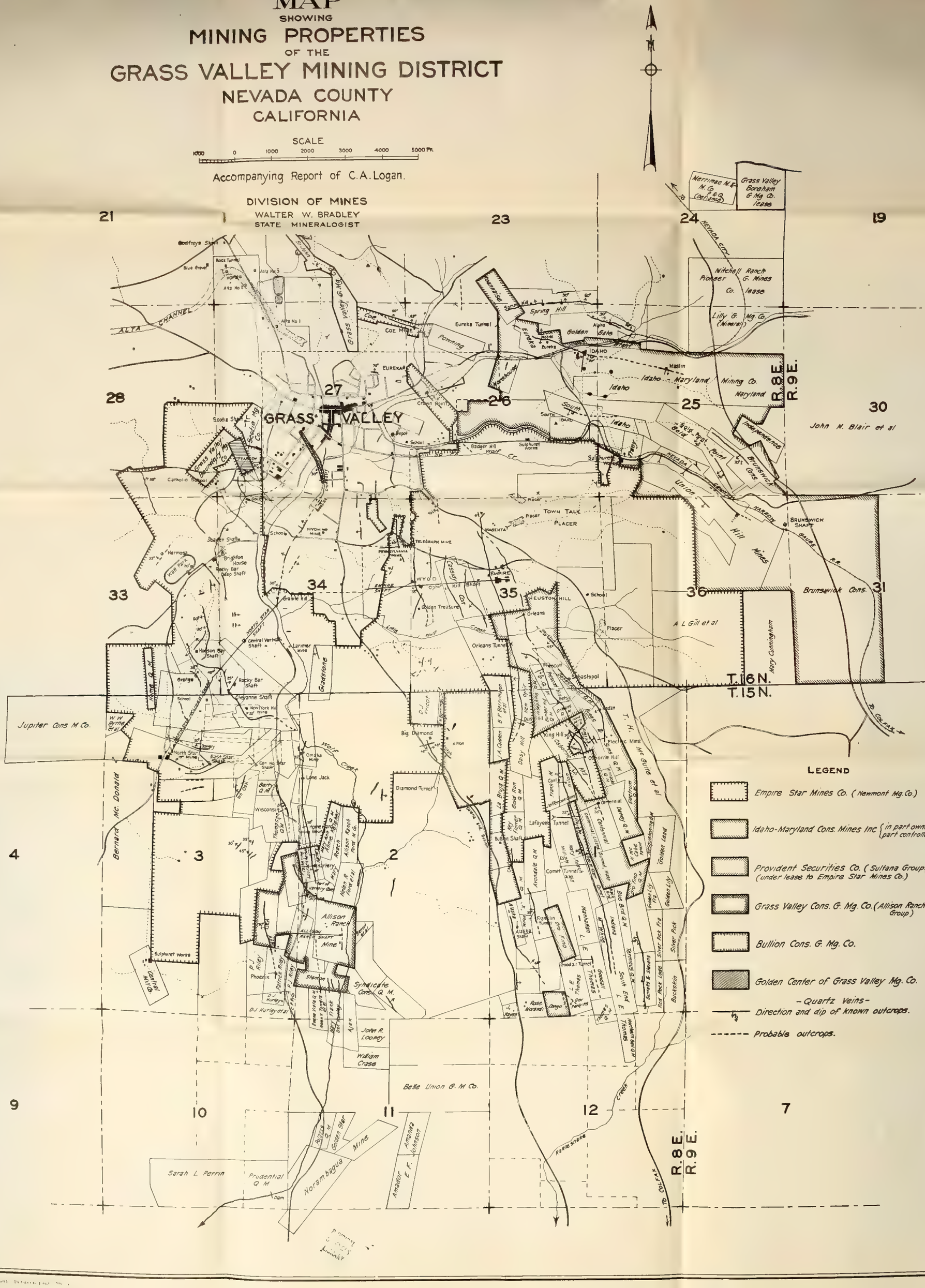
As a result of the attention drawn to its mines, this district has been the subject of numerous geological reports, though unfortunately the secretive policy followed by one of the larger companies has made it impossible to get full details regarding geological conditions in their property. Mining engineers of note, coming to the Grass Valley mines

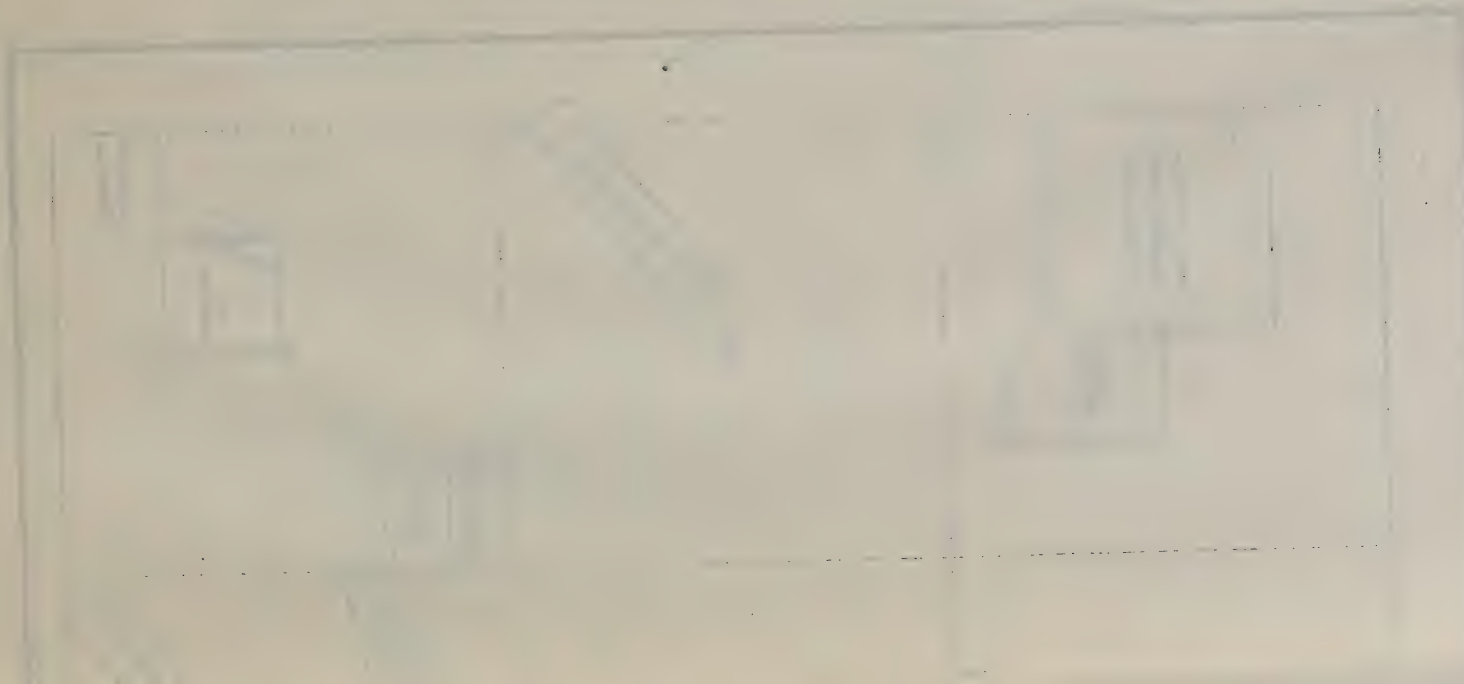
MAP
SHOWING
MINING PROPERTIES
OF THE
GRASS VALLEY MINING DISTRICT
NEVADA COUNTY
CALIFORNIA

SCALE
1000 0 1000 2000 3000 4000 5000 Ft.

Accompanying Report of C.A. Logan.

DIVISION OF MINES
WALTER W. BRADLEY
STATE MINERALOGIST





with ideas gained from experience and observation elsewhere, have too frequently seen their verdicts and predictions overthrown by later developments. As an example, in 1878 the Empire Mine was examined by three well-known engineers, who advised closing it, because they thought it was too deep for profitable operation. By 1883, however, it was again a profitable producer. Again about 1890 a period of lean years began (with a split in the Ophir vein below the 1700-ft. level), and continued until 1898. In 1896 W. B. Bourne had bought back a controlling interest and in 1898 induced George W. Starr to resume management. After an examination, Mr. Starr came to the conclusion that lack of sufficient development work was the chief cause of trouble and accepted the position with the proviso that $200,000 be furnished for the program of development and equipment which he thought necessary. From then on, extensive development was always done, with the result that the mine became the most profitable in the state as well as the largest producer of gold.

The North Star claim was also believed worked out by 1875 when a depth of 1200 feet had been reached, and the property lay idle until 1884, when reopened by W. B. Bourne. It soon became a profitable mine and continued so to a depth below 2100 feet where a pinch in the vein again resulted in the verdict of 'worked out.' This mine had a period of lean years from 1894 to 1900, but after the completion of the Central vertical shaft again became a highly profitable mine; one ore shoot in particular, which narrowed to only a seam above the 500-ft. level, and which was found by pushing the 500-ft. level ahead under unpromising indications, yielded 182,000 tons of ore down to the 2700-ft. level. The results at this property since 1914 are given in more detail in tabulated form (*post*).

The latest example of a mine brought back after being declared dead by experts is the Idaho Maryland, where operations are described more in detail elsewhere in this report. The present showings in this property (which lay idle and unproductive, so far as new development is concerned, from 1900 to 1919) are such as to warrant the hope that the mine may again become, as it was in the past, one of the best producers in the state.

The depths reached in the principal mines, and the operating conditions, are such as to demand the expenditure of large sums for development work. No insufficiently financed company could have made a success of the Empire and North Star mines. This condition is true in all the best known mining districts of the state today.

Geology of Grass Valley and Nevada City Districts.

The areal geology of the mining districts in and surrounding these two towns has been covered in Nevada City Special Folio 29 of the United States Geological Survey, which has some notes on the mines as far as worked up to that time (1896). In their Seventeenth Report, Part II, 1895-'96, Waldemar Lindgren covered the subject, 'The Gold-Quartz Veins of Nevada City and Grass Valley Districts' in detail. From 1880 onward, the various reports of the State Mineralogist have contained many references to the mines of the county. In 1918, a lengthy bulletin, describing most of the gold mines in the county, brought the record up to that time. This book, entitled 'Mines and

Mineral Resources of Nevada County,' is still available at seventy-five cents a copy from the State Division of Mines' offices. In 1924, Ernest Howe, a director of North Star Mines Company at the time, published in Economic Geology, volume 19, No. 7, an article on 'Gold Ores of Grass Valley District' in which he dealt principally with geologic conditions observed over a period of years in the North Star mine workings, but applicable to other mines in the granodiorite.

To summarize Lindgren's report: The principal rocks of interest in connection with the gold-quartz veins are granodiorite, diorite, gabbro, pyroxenite, peridotite, diabase and porphyrite. Serpentine and amphibolite schist are metamorphic rocks formed from the igneous formations. All of these except the granodiorite he regarded as of Jurassic and later age, that occurred in a series, ended by the intrusion of a batholith of granodiorite of Cretaceous age. Compressive stresses to which the region was subjected after this last great intrusion produced joint systems of varying dip and strike, in which the veins were deposited. The principal systems are those striking north with dip east or west as in the Empire; and those striking east, with north or south dip as in the North Star. The older north-striking veins are faulted by the east-striking series. The various kinds of metamorphism are discussed.

He believed the quartz, native gold and auriferous and silver-bearing sulphides (chiefly pyrite, with considerable galena and small amounts of zincblende, arsenopyrite, chalcopyrite and exceptionally telluride) were deposited in open spaces along the fissures by aqueous deposition and by thermal waters also containing carbonates, silica, alkaline sulphides and sulphates, the heavy and valuable metals having presumably been leached by the solution from rocks traversed at great depth, rather than from the immediate wall rocks. The latter, which have yielded silica and soda, are said to carry little free gold. The ore structure may be (1) massive, (2) banded by deposition, (3) ribbon structure by subsequent movement, (4) banded by reopening or successive openings and fillings of a fissure. The width of quartz varies, but the largest average width seldom exceeds three feet, and width may not exceed one foot for a long distance. The nature of wall rocks seems to have had no effect on the contents of the veins. The inference is that the veins are genetically connected with the granodiorite batholith.

Howe classifies the granodiorite intrusion as probably quartz monzonite. Besides describing the north-striking and east-striking vein systems he mentions a group of barren fissures striking northeast and dipping nearly vertically, which cut nearly all the other veins with little or no faulting. He questions Lindgren's theory that the veins were formed in preexisting cavities, and advances the idea that the fissures in the upper part of the batholith were due to tension, caused by expansive force of the intrusion; followed by closing when cooling, shrinkage and subsidence set in. Lateral pressure from the flanks and overlying invaded rocks would, according to Howe, cause reverse faults of moderate throw and with lower angles of dip than the earlier tension fissures. 'Crossings' he thinks belong to the group of earlier tension fissures, essentially contemporaneous with the veins. They usually intersect without displacement of either, or at most not over three or four feet of movement. He believes the primary vein matter,

consisting of quartz with a little calcite and pyrite, was introduced immediately after the formation of the fissures. Later readjustments along lines of weakness were followed by a second period of mineralization characterized by the deposition of quartz, calcite, sphalerite, galena and gold.

The earlier pyrite was shown in thin sections to have been broken or crushed and the original quartz cracked and sometimes recemented by a later generation of quartz or calcite. In about 80% of specimens examined the indications were that the earlier pyrite had precipitated the gold and galena; in the remainder, the evidence was not clear. Howe's theory is that the veins were formed by the direct replacement of broken country rock in the fissures and walls by dilute thermal solutions moving through compound fissures filled with broken rock. He believes this process continued in some cases "until the broken rock was completely in solution."

Lindgren's observations were made before the mine workings at Grass Valley had followed the veins into the granodiorite. The North Star and Empire workings at the time were only 2400 feet deep on the dip and were in uralite-diabase or porphyrite. The North Star workings passed into the granodiorite at an inclined depth of 4000 feet (1600-ft. vertical level), and have been entirely in that rock below there. The workings of the Empire also entered the granodiorite at 1700 feet vertically. Howe's examinations were probably mostly in the granodiorite.

If, as seems necessary, we must recognize two or more periods of mineralization in the veins of the district, it is reasonable and proper to suppose that different processes of mineralization (or successive steps or cycles of magmatic action) prevailed in each period. Many data, previously unpublished, dealing with the subjects of vein formation and ore deposition are discussed later in this article under the descriptions of the Empire, Idaho-Maryland and North Star Mines.

Ore Shoots.

Ore shoots in these mines are not generally extensive in horizontal dimensions though some of them persist well in depth. They range from 50 to 200 feet usually in stope length. The thickness of ore in the Empire Mine over a long period is said to have averaged 15½ inches, and has been much less at many places in both the North Star and Empire. Ore shoots generally pitch nearly in the direction of the dip. The great Eureka-Idaho-Maryland ore shoot was exceptional in that it pitched downward toward the east only about 1300 feet in a total length of about 5000 feet and had an average thickness of 2½ feet of solid quartz and a breadth of 500 to 700 feet. The new Idaho orebody in this mine has a similar flat pitch to the east, judging by present developments. In the North Star, ore is said to have extended from the surface to 1200 feet in depth, where a barren zone was encountered, but ore was found again and extended to 2100 feet on the dip. Another ore shoot extended from the 500-ft. level to the 2700-ft. level. Several barren zones were encountered in the Empire. Generally the ore shoots are in the wider sections of the vein. Narrow seams or fissures with little or no quartz have frequently been followed long distances between orebodies.

ANALYSIS OF GOLD PRODUCTION OF NEVADA COUNTY, 1914-1928*

Year	Quartz mines						Placer mines						Grand total	
							Drift		Hydraulic		Surface			
	No.	Tons, ore	Average	Tons, concentrate	Ton value concentrate	Total value	No.	Output	No.	Output	No.	Output	Gold	Silver
1914	27	274,930	$11 08	3,826	$57 98	$3,057,954	3	$44,326	3	$87,078	5	$112,590	$3,301,968	$26,813
1915	23	315,974	10 91	3,435	22 70	3,428,485	2	31,465	1	4,272	1	2,500	3,466,722	23,762
1916	22	386,692	8 95	2,678	110 97	3,635,978	4	29,700	2	4,200	------	----------	3,669,878	35,741
1917	18	337,596	9 83	1,096	51 11	3,666,577	2	9,351	2	7,019	------	----------	3,682,947	52,335
1918	19	352,301	8 62	3,411	113 15	3,047,370	2	763	3	21,670	2	650	3,070,453	72,557
1919	18	316,027	9 56	5,253	95 82	2,953,783	5	4,311	3	17,833	3	5,385	2,981,312	68,731
1920	14	264,604	11 03	62	181 51	2,860,557	1	----------	3	----------	2	----------	2,872,471	58,476
1921	22	199,678	12 84	73	73 62	2,529,770	6	----------	1	----------	3	----------	2,570,162	33,906
1922	15	268,640	10 63	164	----------	2,836,599	4	42,147	4	20,029	3	798	2,903,573	19,583
1923	14	256,256	8 91	----------	----------	2,251,897	9	28,384	1	264	2	1,610	2,282,155	30,534
1924	------	268,335	10 57	2,454	----------	2,798,009	------	16,508	------	4,290	------	1,225	2,820,032	39,254
1925	16	195,961	11 76	405	----------	2,273,169	7	12,216	3	19,611	3	611	2,305,607	32,155
1926	16	184,924	12 63	239	83 44	2,305,550	5	----------	------	----------	14	----------	2,318,846	30,015
1927	17	192,017	10 08	210	87 30	2,079,289	24	Operators produced			------	[1]47,906	2,127,195	27,581
1928	16	219,264	8 91	2,076	104 85	1,955,307	34	Operators produced			------	[1]38,695	1,994,002	20,798

* From statistics of U. S. Geological Survey and U. S. Bureau of Mines.
[1] Total placer production, not segregated.

Alcalde Gold Mines Company. The property of this company was described in considerable detail in the report on 'Mines and Mineral Resources of Nevada County' published in 1918. From that time until 1923 prospecting work continued at intervals. In July, 1923, a strike was reported and a few thousand dollars worth of high-grade ore was taken out. During the five years following comparatively little work was done. Early in 1928 the holdings were taken under option by the C. C. Julian interests and became one of the group which was to be operated by the *New Monte Cristo Mining Company.* It was planned at that time to continue the old Bowery shaft to a depth of 1500 feet in order to prospect the property thoroughly. However, the Julian holdings in other sections became involved in financial difficulties shortly afterwards and the Alcalde has lain idle.

Late in 1929 the Alcalde Gold Mines Company brought suit against the New Monte Cristo Mining Company seeking to have set aside a deed to the property which they alleged had been delivered to the New Monte Cristo Mining Company by the late George W. Root instead of being placed in escrow as had been intended at the time the option was taken on the property. The plaintiff company alleged that it had received $15,000 at the time of the agreement. The court decided this case against the Alcalde stockholders.

Allison Ranch Mine. This property, which was closed down about 1921 after long and expensive efforts to find new orebodies, was made the subject of a new promotion in 1926. The new company was known as the *Grass Valley South Star Mining Company.* This company spent about $60,000, it is claimed, and acquired some ground on the north known as the Allison Ranch Franklin. They unwatered the Allison Ranch shaft for about 100 feet but it was allowed to fill with water again.

In October, 1929, the trustees of the Grass Valley South Star Mining Company transferred the properties to the *Americ Empire Corporation* which, in turn, is said to have assigned the agreement to the *Ford Allison Mines Corporation.* The properties involved in the transfer included the Allison Ranch Mine holdings and also purchase options on the Allison Ranch Ford, New Idea, and Allison Ranch Franklin claims. The prospective purchasers plan to form a Nevada stock company with a capitalization of a million shares or more and agreed to pay for the property partly in cash and partly in stock.

Ancho Mine in the Graniteville district, which had been lying idle for a number of years, was taken under lease and option late in 1928 by the *Yellow Tiger Consolidated Mining Company.* This company had the property for about one year. After putting the surface plant in condition they reopened the mine and did some underground work. Considerable ore was milled in the 10-stamp mill but the option on the property was finally abandoned as it was stated the company could not profitably operate with the grade of ore in sight.

Banner Consolidated (*Norambagua Consolidated, Incorporated, and Central Consolidated*) was transferred under deed issued June 26, 1929, out of the Nevada County Superior Court to *New England Consolidated Mines.* A. R. Archibald, general manager. Fred E. Nettell,

superintendent, Grass Valley. Nothing has been done for nine years on the Central Consolidated, which lies on the east slope of Banner Mountain 5.7 miles from Grass Valley. All the mill and mine equipment has been sold except a hoist. There is a boarding house and a few smaller buildings near the mouth of the old Central Consolidated drain adit which connects with a shaft 400 feet deeper. Idle February, 1930.

No work has been done on the Norambagua property (which was last described in State Mineralogist's Seventeenth Report, 1920) since that was written. This mine is four miles south of Grass Valley near the state highway. In 1920 it was fully equipped with 20-stamp mill, etc., as mentioned in the above report, but only a little ore was crushed.

Ben Franklin Group, 2¼ miles southeast of Grass Valley, was taken under lease and option in September, 1924, by *Ben Hur Divide Mining Company.* In November, 1924, they began milling rock from the 400-ft. level of the Alaska. Work stopped late in 1926, reported results being poor. In 1928 the 10-stamp mill on the property was sold and moved to the Gracie Mine.

Black Bear Mine, five miles northwest of Grass Valley, has been in the hands of several stock companies, including *Rand Divide Mining Company* and *West Empire Mining Company,* during the past six years but no important results have accrued. Early in 1929 it was leased with option to Cooley Butler, Los Angeles, represented locally by L. S. Wincapaw. A few tons of ore mined near the surface in March, 1930, was milled as a preliminary test and gave fair results.

Carlyle Group. The prospects in the Meadow Lake district were described by the writer in the quarterly 'Mining in California' for October, 1924, which is still available. Since that time there has been very little, if any, work done in the district aside from perfunctory assessment work.

The present Carlyle Group includes the High Grade (now called the Eagle) and adjacent claims on and near the top of Old Man Mountain and the ground extending down the south side of the mountain to and including part of the old Carlyle district on Fordyce Creek. There are 24 claims held by location. All of the claims in the group have been relocated or newly named so that they can not be readily identified with claims mentioned in the report of 1924. *Metal Products Corporation,* a Nevada stock company, has announced it will begin work the present summer on the claims. There is a road eight miles long from Cisco, the nearest railroad station, to Fordyce Lake, about one-half mile from Carlyle. If the power company owning Fordyce Lake would permit it, a connection could be made with the Truckee-Meadow Lake road by crossing on the dam at the lake and building about a mile of new road. Otherwise, a bridge would be needed at Carlyle.

Old Man Mountain has an elevation of 7800 feet and the winters in the region are quite severe as it is near the summit of the range. The region has been glaciated and for that reason sulphide ores were encountered at or within a few feet of the surface by the pioneers who established the camp in 1863. Granodiorite is the country rock of

most of the area. Both walls and vein fillings tend toward the basic end of the igneous rock series. At times the veins and wall rocks merge into each other, indicating primary ore deposition by segregation. Elsewhere, some veins appear to be ultra-basic dikes. Pyrite occurs plentifully, in many cases in the proportion of 10% to 20% of the vein material. Copper sulphides are common but usually in small proportions. Zincblende, arsenopyrite and other sulphides also have been found at places in the district.

The High Grade (now the Eagle) has been prospected by short adits on the south side of the mountain and a small tonnage of ore was shipped many years ago. It was operated in 1895, when a company built a tramway to Carlyle and shipped some ore. Fifteen years ago or more another firm installed a tramway and took some ore as far as Carlyle, but quit before sending it to a smelter. Carlyle is 2700 feet distant and 1700 feet lower than the lower adit, which is estimated to be 400 feet below the summit.

For more details about the district, the reader is referred to the article mentioned above.

Champion Group. This group of mines in the Nevada City district, owned by *North Star Mines Company*, is in part under lease to *Yellow Tiger Mining Company*, Gordon Bettles, manager, Nevada City.

North Star Mines Company quit work at the Champion in July, 1920, after several years of unprofitable operation in the Providence, Champion and Nevada City claims. Engineers acquainted with the district believe that the possibilities of the group, which covers 440 acres, are far from being exhausted. The property and operations were described at length in the report on 'Mines and Mineral Resources of Nevada County, 1918,' pp. 135-143, inclusive.

The group includes the Providence, Home, Merrifield, Spanish, Wyoming, and Nevada City mines, each of which was a consolidation of groups of claims. It covers about 8000 feet along the Ural and Merrifield veins. While no complete and authentic record of the production of these mines has ever been made, it is estimated that the combined total output of these vein systems has been close to $10,000,000. The production under North Star Mines Company from 1911 to the time of closing in 1920 was 273,710 tons which yielded $1.506,673.

Both the Champion and Providence shafts were sunk in the later years of operation to 2700 feet on the dip. From the Providence side on the 2700-ft. level a winze was sunk and some drifting done on the 2800-ft. level. The Providence ore shoot was a remarkably strong and persistent one, having been followed from the surface to the 2700-ft. level, where it had a stope length between 300 and 400 feet and was two to ten feet thick. The Champion ore shoot was bottomed at about 1200 feet. Some stoping was done on that side from about 1600 feet in depth, connecting with the 700-ft. level on the Nevada City ore shoot. Some ground was stoped on the 2400-ft. and 2700-ft. levels.

Geological and mining conditions in this property are different from those at Grass Valley. The veins are generally not less than two feet thick and dip at angles of 35° to 40° so that less shoveling is required and less waste has to be handled. There is no specimen ore in depth.

The concentrate averages about 6% of the ore and carries about 30% of the gold. The ground is heavy, requiring modified square setting. Timber has an average life of about 18 months. Detailed costs are given in the report cited above.

W. H. Collier, Nevada City, has subleased part of the Ural claim, a mile from Nevada City on the Downieville highway, from Yellow Tiger Mining Company who hold a lease from the owners. He has been working since November, 1929, using five light stamps to crush surface ore.

The Ural and Wyoming veins come close together and probably intersect at shallow depth here. Several shallow shafts sunk along the Ural vein in earlier days yielded small tonnages of good ore in the vicinity of the supposed intersection but these are caved. The Wyoming vein is said to be unworked to a depth of 400 feet but was worked below there. The Ural vein was worked extensively and furnished a large part of the ore mined north of Deer Creek by North Star Mines Company. The erosion of the vein has distributed enough fine, free gold in a shallow layer of soil to permit mining and milling at a small profit, if Collier's estimates and past reports are correct. Ore mined and milled in the past from the surface yielded $2.65 to $6.50 a ton.

Defiance Group. Philip Curnow, North Columbia, owner. It contains five quartz claims adjoining the Delhi Mine on the west, four miles north of North Columbia.

On the West Delhi, a fractional claim, a crosscut adit has been run 800 feet north and west, with a drift 850 feet long on the formation. This is about 700 feet in elevation above the river. Quartz carrying arsenopyrite was found at times. The formation strikes northwest and quartz is two feet wide in places. No mill tests have been made and no samples have been taken except pan samples, so far as could be learned from the owner.

Eagle Bird Mine is seven miles east of Washington by road, which is in part rough. Dr. West Hughes, 432 South Main street, Los Angeles, is the principal owner. The past history, and the surface geology, as well as many details of the underground workings, are given in the Nevada County report of 1918. Comparatively little work has been done since that report was written, but additional data concerning the mine have been obtained. The holdings include three patented claims, 160 acres of patented timber land and four locations on another vein, which runs parallel to the Eagle Bird vein about 600 feet to the west of it and is practically unprospected. The claims extend southward from South Yuba River for 4500 feet at elevations increasing from 3500 to 5000 feet.

From the shaft, which was sunk on the vein on an incline of 65° to 800 feet, levels numbered 1 to 8 were run the following distances south along the vein at the depths indicated below the surface:

Level	*Depth*	*Distance drifted south*
1	62 feet	560 feet
2	132 feet	690 feet
3	192 feet	850 feet
4	272 feet	780 feet
5	374 feet	960 feet
6	476 feet	930 feet
7	578 feet	220 feet
8	680 feet	250 feet

The drifts run north of shaft were short. No. 3 level was run 320 feet north, No. 4, 195 feet and others less. An adit level, started 50 feet south of the shaft and 50 feet above it, was run south 1185 feet, gaining backs of about 700 feet.

The workings could not be visited because of insufficient power for hoisting. Both walls are reported to be granodiorite to the sixth level, but 'diabase' forms the footwall on the seventh level and shows on the south from the fourth level.

Only a small amount of work has been carried on irregularly in late years. In the previous work, the south ore shoot was stoped through from the winze below No. 6 to a height of 160 feet above the adit level. Below No. 6 level this shoot, which was reported to be 375 feet in stope length by as much as 12 to 20 feet thick in the upper levels, narrowed to 100 feet in length. Another ore shoot was also stoped on the south side of shaft. In the No. 8 level the vein was wide but too low grade to be ore. An orebody 35 feet long by 7 feet thick is reported between No. 2 and No. 3 levels north of the shaft.

There is a mill of ten stamps and mine equipment includes two air compressors, drill sharpener and hoist. Water from South Yuba River has been used in the past for power and the property is supposed to have rights of long standing to 1000 miners inches but complaint has been made that other users have been cutting off a large part of this in summer. There are several good buildings on the claims.

In 1926, a crew of a few men worked 64 days. Since then only about 40 feet of new work has been done underground in addition to keeping timbering in repair. In 1928 a new head dam was built, diverting nearly all the summer flow into the company's ditch. When visited in 1929, principally repair work was being carried on by Clayton Chatfield, superintendent, and a few men.

Empire Mine. Empire Star Mines Co., Ltd., the operating company, is controlled by Newmont Mining Corporation. The transfer of the property to the new owners was made on May 1, 1929. W. A. Simkins, western manager. F. W. Nobs, superintendent.

The early history of the Empire, which has grown up as a consolidation around the Ophir claim, discovered in 1850 (see map), has been covered in the report 'Mines and Mineral Resources of Nevada County' published in 1918. The mine has been worked continuously since 1850. From 1898 to 1928 it was in the hands of a corporation with only a few stockholders, and a policy of secrecy was maintained so that in later years little has been known of the operations. In this later period the mine became the largest and most profitable quartz gold producer in the state, surpassing its neighbor, the North Star, with which it has been consolidated by the present owners. In the period of 30 years of operation by Empire Mines and Investment Company, from 1898 to 1928 this property (including the Pennsylvania) yielded, according to reliable estimates, about $41,000,000 and paid annual dividends ranging from $240,000 to $1,000,000 over the greater part of this period. In the last few years of operation under this company, however, the grade of ore decreased from a value of over $14 a ton to about $9 a ton.

Because of the size of the property and the extent of the workings, and lack of cooperation in the past on the part of the operators who

have maintained a policy of strict secrecy about the mine's affairs, it is impossible to give the detailed information about the geology of the property which its importance warrants. One day spent underground permitted a hurried examination of a few of the levels. The writer is also indebted to Mr. A. F. Duggleby, geologist for the company, for a synopsis of many important points which have come to his attention during his examinations carried on since the present company took control, and for suggestions and advice during the preparation of this article.

Taking first a general view, it may be said that the mine is bounded on the north by a large fault along the north side of the granodiorite batholith in which the veins occur at depth in this district. This is a premineral fault of large but unknown throw, against which the Empire vein stops. The fault strikes northwest and dips steeply northeast. The Empire vein striking north and dipping west at an average angle of about 35°, passed into the granodiorite (quartz monzonite) at 1700 feet depth and continues in that formation to the bottom level, 7000 feet on the dip. The Pennsylvania vein and Kate Hayes or X vein outcrop in the granodiorite of Kate Hayes Hill 3000 and 4000 feet, respectively, northwest of the Empire shaft, which is about 6000 feet southeast of the center of Grass Valley. The area of diabase in which the Empire or Ophir Hill vein outcrops is about 5000 feet wide, and has been extensively shattered and contains at the surface many veins, but the principal development and production has in later years been upon the veins named, over a total length of about 2½ miles. South of the Empire, along the strike of the interlinked vein system, lies the *Sultana* property, at present under lease to the operators of the Empire. This is a consolidation of the Orleans, Prescott Hill, Electric, Centennial and other claims, numbering 27 in all. These cover about two miles on the strike of the vein system. A maximum depth of 2100 feet was reached in the later operations in one of the many shafts (see 'Mines and Mineral Resources of Nevada County,' 1918, and 'Report XVIII of the State Mineralogist,' 1922). The work to that depth had all been in the diabase. Several levels had been driven to the Empire line. Exploration of the Sultana fracture system at lower elevations has been carried out by the lessees who have extended the Empire 3000– and 3800-ft. levels to the south limits of the property. This work has found ore-bearing, east-dipping veins but has not succeeded in locating the downward extension of the Sultana vein system, which is west-dipping.

Mine Workings and Relationships of the Veins.

The Empire shaft has been sunk to an inclined depth of 4600 feet, following the vein in its upper part, but between 2800 and 4200 feet the dip of vein steepened to 55° and in this lower section the shaft goes off into the hanging wall so that near the bottom crosscuts back to the vein were required. For the most part, little timber was used in this shaft except that needed to support rails and pipe lines, as the walls are hard and firm. From the 4600-ft. to 7000-ft level, an inclined winze was sunk on the vein near the south end of the main ore shoot. The Pennsylvania shaft was sunk on the Pennsylvania vein to the 3400-ft. level (3400-ft. level of the Empire). Below there, this vein was developed through crosscuts from the Empire down to the 4600-ft.

level, the veins being about 3000 feet apart and about parallel in dip and strike in the northern part of the workings. To the south, the Pennsylvania joins the X vein which strikes southeast and dips southwest. In the years when the North Star and Empire were worked by separate companies, a dispute arose as to rights below the 4600-ft. level and a compromise vertical boundary was established. In 1914, when the North Star main inclined shaft reached a depth of 6300 feet on the dip on the North Star vein this X vein was encountered. It strikes about parallel to the North Star vein but dips southwest, which is opposite to the dip of that vein. It was found that the X vein cut off the North Star vein and continued downward itself. It was called the No. 1 vein in the North Star and was subsequently followed to the 8600-ft. level and was stoped from the compromise line (about the 5400-ft. level of the North Star and near the 4600-ft. Empire level) to the 8600-ft. level of the North Star, furnishing most of the ore produced in the last three years' operation of that mine. A. F. Duggleby considers the X vein the same as the Kate Hayes. The North Star development also showed a vein called No. 2, branching from the X vein 1200 feet east of the shaft, striking north and dipping west. The extension of this fracture north of and under the X vein is known as the No. 3 vein.

Besides these productive veins there occurs in the mines a series of crossings, which are steeply dipping barren fissures of premineral age striking generally northeast, which are believed to be of great importance, as mentioned later. The large block of ground explored in the two mines is thus seen to be cut up into rhombohedral blocks by (1) a series of north-striking conjugate veins (Empire, Pennsylvania and No. 3 'A') roughly parallel to the main diabase slate contacts; (2) a series of northwest-striking conjugate veins (X, North Star, New York Hill, etc.) parallel to the limiting fault line mentioned above; and (3) earlier barren crossings. They are bounded on the north by a major fault; on the west by the Carboniferous slate. The east and south slopes of the batholith have not been explored to any great depth; east of the Empire the country is covered by andesite and to the south the deepest development has been 3800 feet in the Sultana.

Sequence of Principal Geologic Events.

In the Empire-Star properties, the most important geologic happenings in connection with the formation of the ore deposits may be set down chronologically as follows:

Deposition of diabase (porphyrites or 'greenstones').

Intrusion of granodiorite batholith and outliers, with resultant major faulting on north as mentioned, and the creation of a series of stresses resulting in formation of steep crossings striking northeast. As a closing phase of this intrusion complementary acid and basic dykes were injected into some of the crossings. Some believe the stresses were compressive; others that they were tensile. The crossings were evidently formed before the veins.

Later series of stresses, believed compressive by Duggleby but according to Ernest Howe possibly tensile, due to the cooling, shrinkage and subsidence during the solidifying of the upper part of the batholith, resulted in the formation of the fissures in which ore veins were formed. As a crack in a sheet of plate glass will stop when it reaches some large

earlier crack, so it is believed that the earlier crossings determined the extent of the latter fracturing, and this appears to check with observations underground. As observed in the North Star workings by the writer (and mentioned in notes on that mine published in 1918) and in the Empire, the fractures seem at times to have followed lines of weakness caused by segregations of the basic constituents of the granodiorite. They have not been displaced where passing from diabase to granodiorite.

The primary veins filling or party filling these fractures and receiving material from the magma at the base of the batholith either by ascending a 'ladder' of conjugate vein systems or through major crossings were of minor metal content, consisting principally of quartz with some calcite and pyrite.

Further readjustment caused movement enough to shatter quartz and pyrite crystals, partly reopened fissures, and the gold bearing solutions with galena, quartz, calcite and a little sphalerite came in. Gold and galena were deposited, often on the faces or in cracks in pyrite crystals. Later, calcite and in places some scheelite were deposited. Crossings, according to Duggleby, were favorable places for the accumulation of ore and enrichments only because at these intersections a greater area of opening for the passage of solutions was available.

Post-mineral faulting as indicated by gouges and crushed quartz has not generally been important in the Empire and North Star, so far as following the ore was concerned.

Character of Veins.

The present operations on the Empire vein are in a number of small stopes on different levels from the 3000-ft. to 7000-ft level. An inspection of the Empire vein at such a typical level as the one at 3400 feet shows in places a tabular quartz vein without included wall-rock breccia, indicating deposition in an open fissure; it has at times banded structure. Again, in places the filling is largely a breccia of angular wall-rock fragments. For an explanation of these variations we can turn to the familiar idea of a preexisting fissure[1] along which the walls were not everywhere equal distance apart. The tabular bodies of quartz may reasonably be considered the filling of open spaces, with wall rock dense and strong enough to maintain spaces with the support offered where the walls met at the ends of the arches. Movement during earlier mineralization probably caused the grinding and brecciation of wall rock where the walls met in opposing prominences. The vein varies in width from a few inches of quartz to a width of nine feet filled with quartz and breccia, all of which must be mined to keep solid walls. While not all crossings influence the vein, such a junction may show veins branching into the surrounding area, forming orebodies. Here the aspect is of a stringer lead. On the north the vein turns to the east in a series of crossings in the region of the fault zone. On the south it also dies out by dissipation of the fracture along repeated crossings. The wall rock is often hard and unaltered close up to the vein. It is said no ore is found except in the quartz, and that

[1] According to A. F. Duggleby, "Numerous instances are seen of 'comb' structure showing freely formed quartz crystals growing out into open fissures with calcite, sulphide and gold bearing quartz filling in between them."

assays show gold along the narrow sections where the vein may close down to a width of only a few inches.

On the 7000-ft. level the contact of a diabase dike with the granodiorite is revealed. This dike was intruded into a crossing which strikes N. 40° E. and dips 80° N. W. Here the Empire vein has formed a stringer lead 7 to 8 feet wide, striking the disturbed zone on the dip and passing into the diabase. In the immediate contact a seam of quartz one-half to one inch wide occurs, with a streak of sulphides up to one-fourth inch thick on the footwall side. This is the lowest working in the Empire.

The X vein south of the junction with the Pennsylvania is a strong fault fissure on the 4600-ft. level, where it is filled with brecciated and ground country rock and comparatively little quartz. What is said to be a typical section of this vein shows a lens of quartz near one wall (in a fissure perhaps several feet wide filled with broken and crushed rock) with the next lens overlapping or near by, near the other wall. These unbroken lenses of quartz were evidently deposited after the main period of faulting and are probably the basis for the theory that the ore was formed in a previously rock-filled fissure. This vein, as already mentioned, was worked to the 8600-ft. level in the North Star, but not below the 4600-ft. level in the Empire.

Ore Shoots.

The largest and most productive ore shoot has been the Empire. It pitched north, had a maximum stope length of about 2500 feet and was most profitably productive from the 2700-ft. to 4600-ft. level. The ore is said to have averaged 15½ inches in thickness over a long period, but at present averages about 12 inches. In an exceptional case a width of eight feet of quartz was mined. Barren or narrow zones, where the vein though assaying well was too small to pay for mining, occurred at intervals for depths of several hundred feet. From 3400 to 3800 feet was about the center of this shoot.

On the Pennsylvania vein, two ore shoots each about 600 feet in stope length were mined from the 1000-ft. to 2400-ft. level of the Pennsylvania shaft, which is at about the south end of the ore.

About 1000 feet in length on the X vein, from the 1400-ft. level to the 4600-ft. level of the Pennsylvania, carried ore, irregularly distributed. This vein was also stoped for a length of 1400 feet in the North Star from near their 5400-ft level to the 8600-ft. level. The grade of ore from its lower levels was much poorer than from the Empire or North Star main ore shoots in their upper portions.

Taking into consideration the average width of veins and width stoped it will be seen that the clean quartz ore in the shoots has had a high average value per ton, though this has been due in part to occurrence of specimen ore. With pay coming from quartz veins often six to eight inches wide and averaging 12 inches, where stopes usually have to be carried about four feet wide, and with the fissure filling often including so much barren rock that a thickness of eight or nine feet may have to be stoped between walls, it will be seen that rock milling $9 to $15 a ton means clean ore assaying $35 a ton or more, if it were practicable to make a clean separation of ore and waste.

Mining.

The average dip of the vein is too flat to allow ore to run freely. Open stopes average 48 inches high and are carried on stulls with some back filling of coarse waste sorted out in mining operations. Ore is gathered by hand tramming along stope drifts and delivered to central go-devils or chutes where it is transferred to main levels which in the lower part of the mine are 400 feet apart. Mule haulage along these takes it to the hoisting shafts except on the two main haulage levels, 4600 Empire and 8600 North Star, where storage battery locomotives are used. Stope drilling is done by heavy mounted machines. The ground is seldom suitable for jackhammers. Mining methods at North Star mines are mentioned in the article on that property in this report.

Metallurgy.

The flow sheet of the Empire mill and cyanide plant, which are now handling all the ore from the North Star and Empire mines, is shown herewith. The North Star mill has been closed down since the present owners took charge. An overhead tram is being completed to deliver ore from the North Star (Central vertical shaft) to the Empire mill, where 80 heavy stamps are in commission.

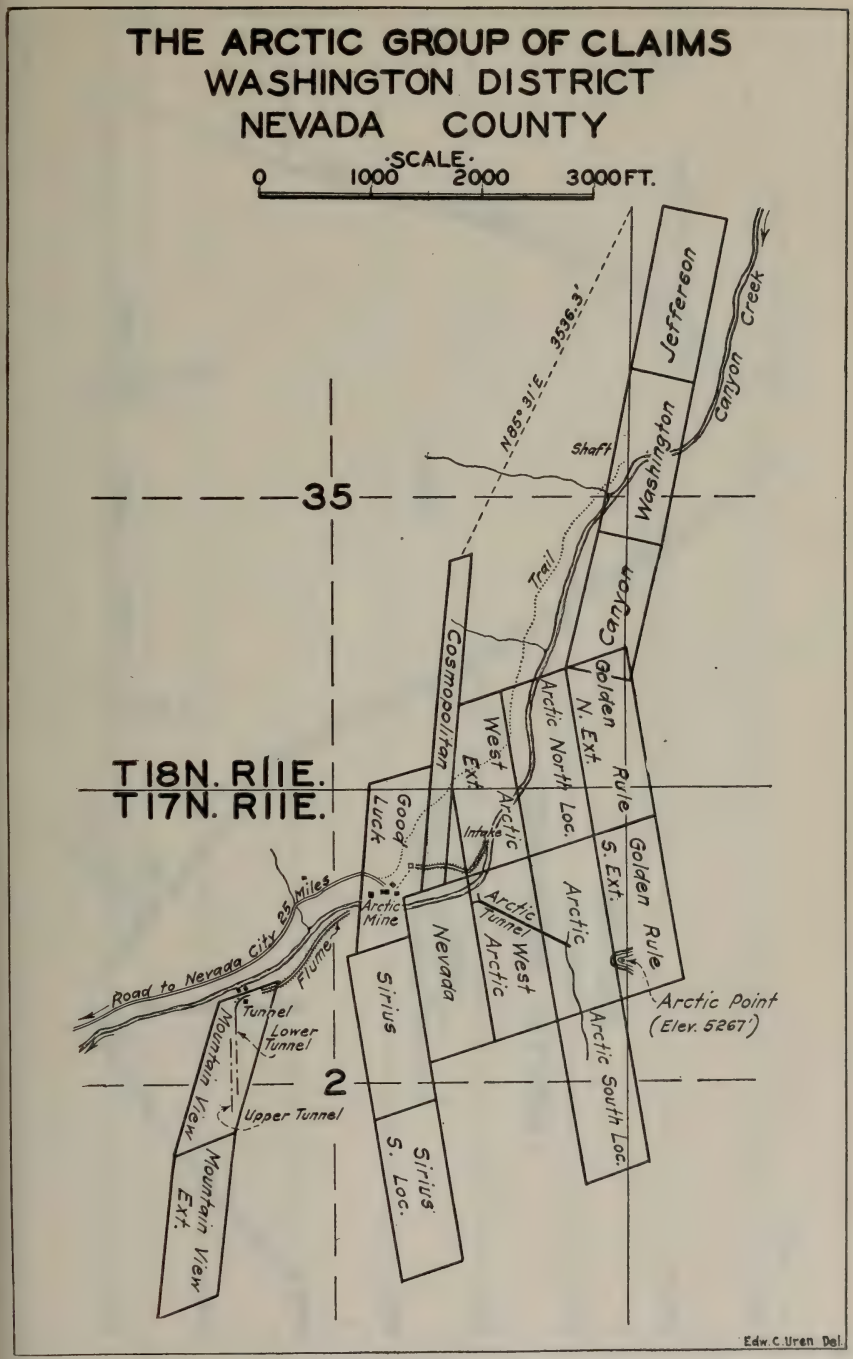
Gaston Mine is six miles northeast of Washington, and 24 miles from Nevada City by road. It has been the principal producer of the district and has been described at length in previous reports, first in Report VIII, 1888 under the name of Gaston Ridge, and more recently in 'Mines and Mineral Resources of Nevada County,' 1918. It lay idle for ten years after the latter report. In June, 1928, *Rescue-Eula Mining Company* started to reopen and prospect it.

In December, 1928, they started milling and in the course of four months they milled over 2000 tons which yielded from $1 to $11 a ton, but did not average enough to pay the cost of operation and development, which was about $6 a ton according to the statement of Otto Schiffner, manager during these operations. All work was done from the lower adit which had reached a length of 4876 feet in 1918. The last operators did about 400 feet of lateral work on this level which is 1900 feet below the outcrop. They gave up their option in August, 1929.

The Gaston vein orebodies occur at or near the contact, having the Blue Canyon (Carboniferous) slate on the footwall and granite on the hanging wall.

In the lower adit level about 350 feet was on ore and 'near-ore' of the grades mentioned above. The lower adit (drain tunnel) is 800 feet below the old adit, which was the former entry for mining operations, and below which the orebodies were formerly worked to a depth of 500 feet through a winze.

Water was formerly furnished for power from North Bloomfield ditch, which crosses the upper part of the property. In the last work, South Fork of Poorman Creek was utilized. It gives a supply for about seven months in the average year. The new power line to the Spanish Mine passes about a mile and a half from the Gaston, and electric power could be had at reasonable cost.


THE ARCTIC GROUP OF CLAIMS
WASHINGTON DISTRICT
NEVADA COUNTY
SCALE
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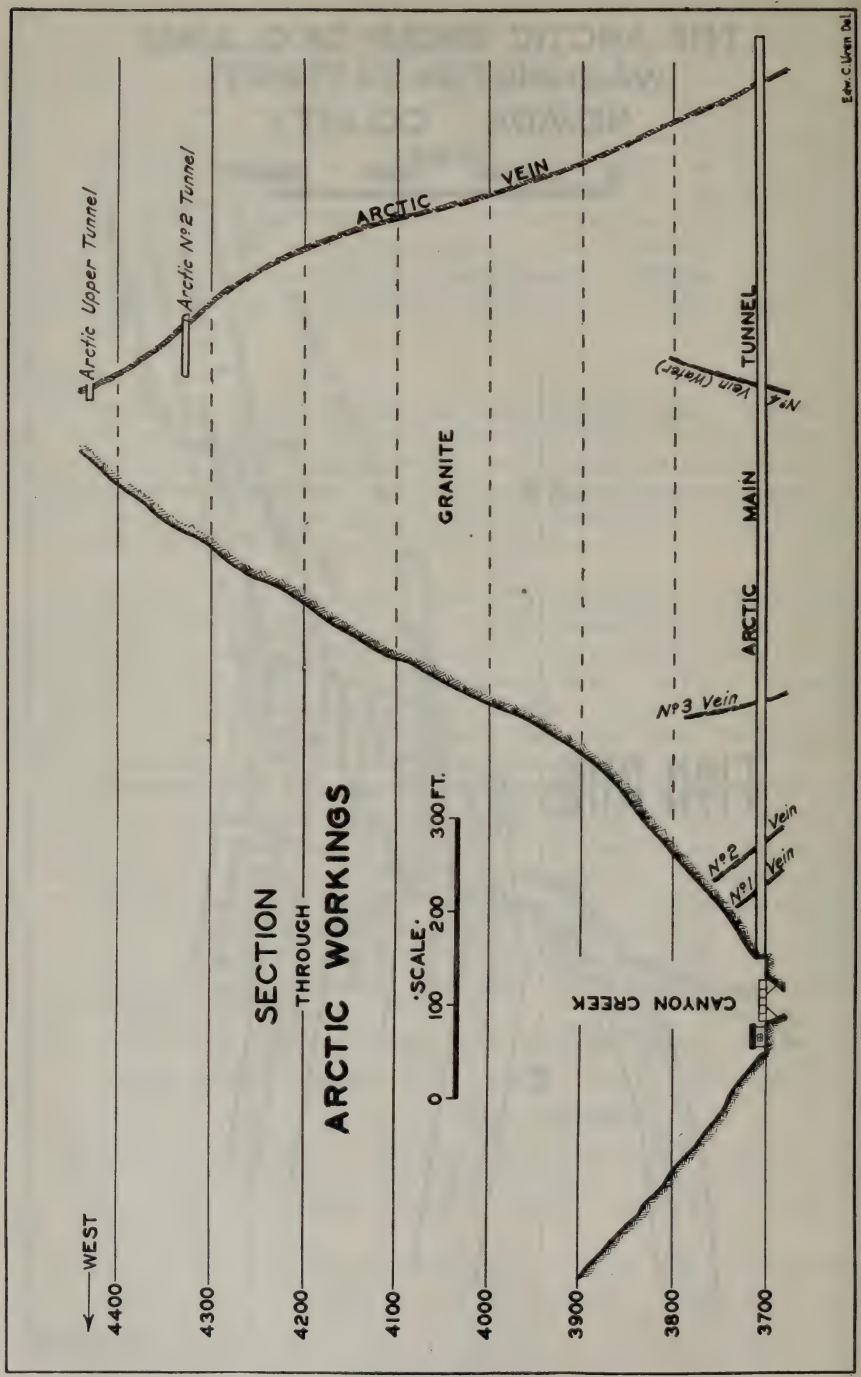
N85°-31'E 3536.3'
Shaft
Trail
35
T18N. R11E.
T17N. R11E.
2
Jefferson
Canyon Creek
Washington
Canyon
Cosmopolitan
Golden Rule N. Ext.
West Ext.
Arctic North Loc.
Good Luck
Intake
Arctic Mine
Arctic Tunnel
Golden Rule S. Ext.
Arctic
Nevada
Arctic West
Sirius
Arctic South Loc.
Sirius S. Loc.
Arctic Point (Elev. 5267')
Road to Nevada City 2.5 Miles
Flume
Tunnel
Lower Tunnel
Upper Tunnel
Mountain View
Mountain View Ext.
Edw. C. Uren Del.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4300
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Arctic Upper Tunnel
Arctic No 2 Tunnel
ARCTIC VEIN
GRANITE
ARCTIC MAIN TUNNEL
Vein (Water)
No 4
No 3 Vein
No 2 Vein
No 1 Vein
CANYON CREEK
Edw. C. Uren Del.

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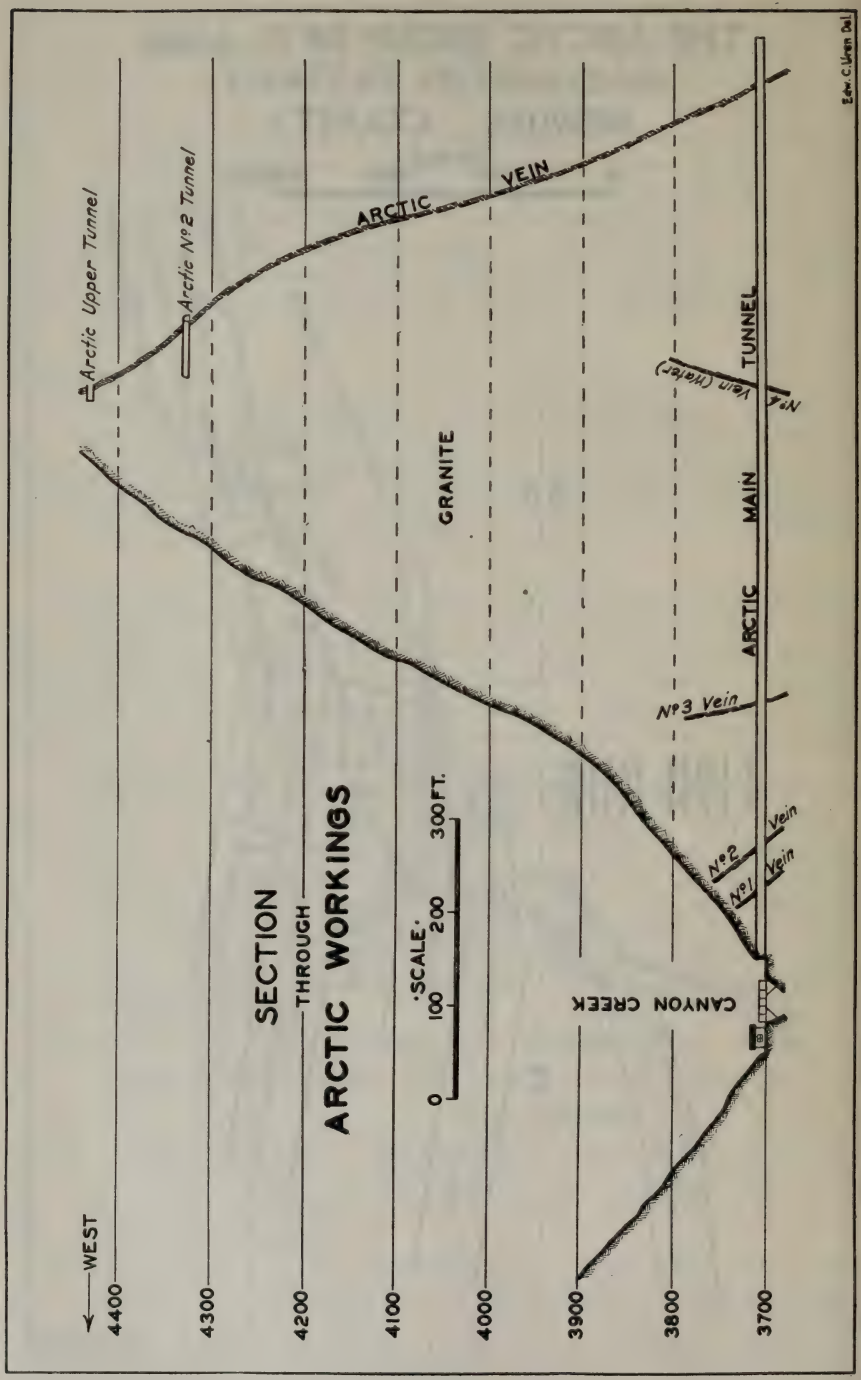
SECTION
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Arctic Upper Tunnel
Arctic No 2 Tunnel
ARCTIC VEIN
GRANITE
No 3 Vein
ARCTIC MAIN TUNNEL
Vein (Heater)
No 4
No 2 Vein
No 1 Vein
CANYON CREEK
Edw. C. Ulrich Del

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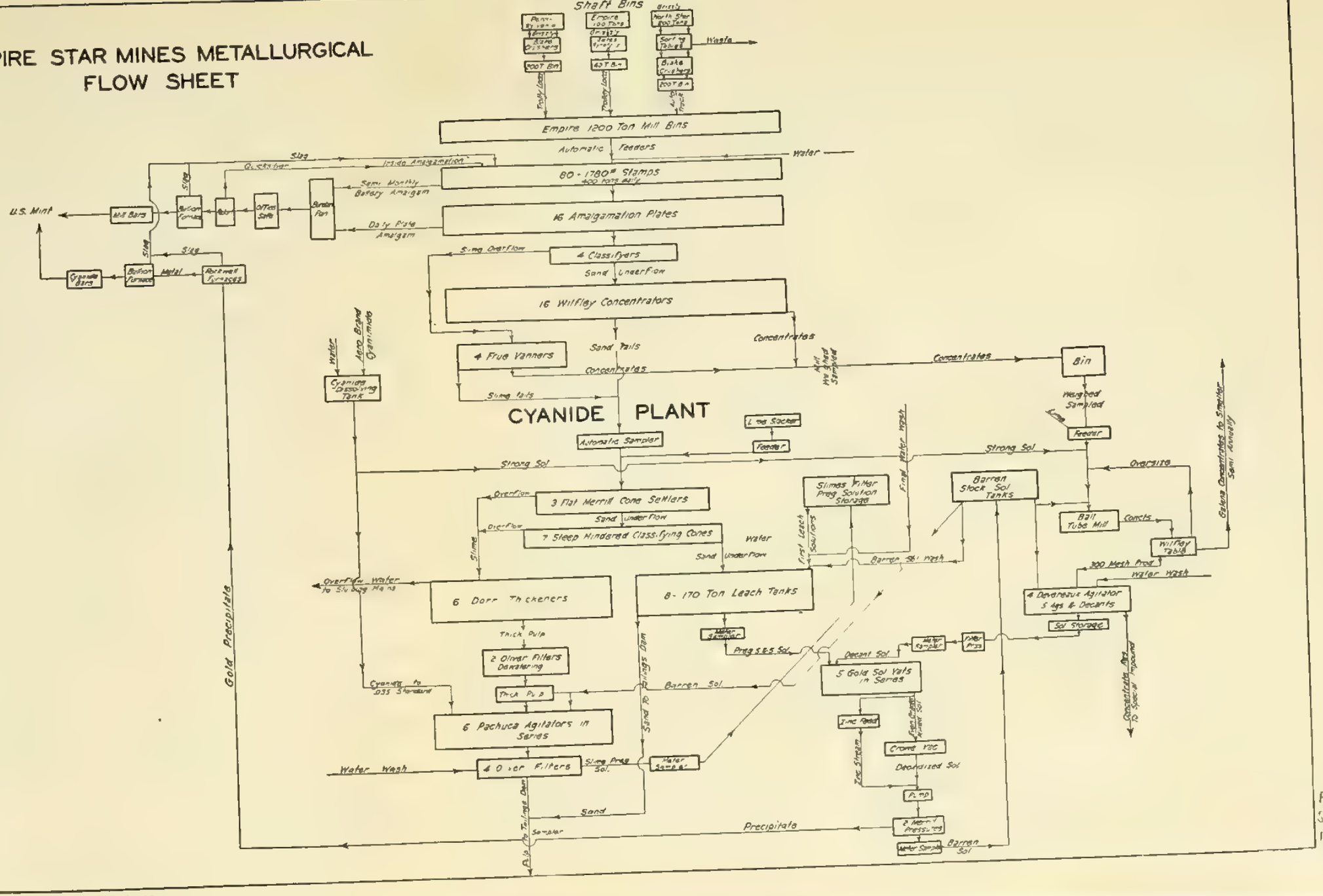
EMPIRE STAR MINES METALLURGICAL FLOW SHEET



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When the Gaston Mine was closed in 1918 a moderate tonnage of $4 ore was claimed to be blocked out by the then owners, as mentioned by this writer in 'Mines and Mineral Resources of Nevada County,' where it was also stated that the cost of mining, milling and overhead had reached $3.92 a ton.

Gracie Mine in Nevada City district a mile southeast of the town, was taken under lease and option in the fall of 1927 by Dr. E. H. Herrington. There was an old shaft 100 feet deep and a drain tunnel tapping it. Sinking was continued to the 190-ft. level where ore was found. A drift was run 200 feet west and 100 feet east. In June, 1928 a 10-stamp mill was moved from the Ben Hur Divide (Ben Franklin) property near Grass Valley and was ready for operation in July, 1928, when some ore was tested. Hardly a week had elapsed, however, when the mine was closed on account of an influx of water said to come from leaks in a ditch crossing the property.

It was nearly a year before work was resumed. *Cascade Milling and Development Corporation* was formed to work the property and sank the shaft to 400 feet. Drifting was started on the 350-ft. level late in 1929 but evidently expectations of striking ore reported in a winze sunk 62 feet below the 190-ft level were not realized, as the property was idle in February, 1930.

Besides the mill, the property has an electric hoist, compressor and pumps.

Grass Valley Boreham Gold Mining Company (*Boreham Mine*). A. O. Witte, president. Address: 1175 North Vermont avenue, Los Angeles. Austin Boreham, superintendent.

This property is on the south slope of Town Talk ridge just southeast of the old Merrimac mine and two miles south of Nevada City.

An inclined shaft has been sunk on the vein for 200 feet giving perhaps 135 feet vertical depth. From the bottom, a drift runs on the vein in a direction S. 20° E. for 180 feet, and north of shaft for 100 feet. In the south drift 60 feet from the shaft, a fault striking N. 65° W. and dipping 58° E. crosses the vein. Quite probably this marks the junction of another vein although no work had been done in either wall at time of visit to investigate it. At and near this crossing the vein is six to eight feet wide of which a strip one to two feet on the footwall side is reported best, except at the immediate junction, where the entire vein is claimed to carry gold. The hanging wall is serpentine and footwall Calaveras schist, black and often called slate because of an imperfectly developed slaty cleavage. Pay in this south drift stops at this fault according to Boreham. At the shaft, he states another fault yielded $2000 in high-grade ore from one round of shots. North of the shaft the vein shows a width of $2\frac{1}{2}$ to 3 feet in a raise and up to $7\frac{1}{2}$ feet in the drift. Both walls are free and carry gouge. At the north end the ground tightens up and the face shows the blocky dike (Calaveras) shot with stringers of quartz. There is much less evidence of movement here. The Boreham Brothers claim there is an ore shoot 140 feet long, from the south fault to a point 80 feet north of the shaft. Very little ore has been removed above the adit.

Equipment consists of a 1-drill compressor run by a 13-h.p. gasoline engine, a hoist and a 2-stamp mill both operated by water power and two 3-inch injectors for dewatering the mine. There is considerable seepage in the south drift from a ditch crossing the property. Water for power is purchased from Nevada Irrigation District at 10 cents a miners inch daily. No work was being done underground at time of visit.

Grass Valley Gold Mines Company was formed in 1923 to prospect on Alta Hill, just north of Grass Valley for possible extensions of some of the productive veins worked in other mines of the district. While the area in question is mostly lava capped and outcrops of bedrock are largely of serpentine, it was the opinion of Roy King, who promoted the project, that these veins should converge there if they maintained their observed strike. A vertical prospect shaft was started in April, 1923 near the old Hope shaft. This shaft had reached a depth of 415 feet, with several hundred feet of crosscuts at a depth of about 275 feet, when operations were halted by lawsuits begun in December, 1924, by various owners whose lands had been under option to the above company.

Since that time, litigation has been intermittent, going to the Supreme Court of California where the decision went against the landowners. It was reported late in 1929 that the original agreement was to be kept in effect, the landowners taking stock in the company. Soon after, Roy King brought suit to force transfer of a block of stock alleged due him. There are said to be over 775,000 shares of stock outstanding. The property has been under option for some time to Los Angeles interests.

Idaho-Maryland Mine. Idaho-Maryland Consolidated Mines, Incorporated is the holding company, and Idaho-Maryland Mines Company is the operating company. The latter nominally owns the Eureka, Idaho-Maryland, Gold Point, Union Hill and South Idaho. In March, 1919, Idaho-Maryland Mines Company gave a mortgage on its property to Mercantile Trust Company, San Francisco as trustee to secure payment of 2000 bonds of a par value of $500 each. The present operations are being carried on by arrangement with the trustee as the mortgage has not yet been cleared. Besides controlling the operating company, Idaho-Maryland Consolidated Mines, Incorporated, owns the Morehouse and 90% of the stock of the Brunswick. The Brunswick owns the Matteson Ranch Property of 320 acres. The total controlled by the holding company is about 1000 acres in the northeast part of the Grass Valley district one to two miles east of the town. E. L. Oliver is president and Errol Mac Boyle managing director.

The past history of the several mines in this consolidation was covered in the report on 'Mines and Mineral Resources of Nevada County' published by the State Mining Bureau, in 1918. In 1919, *Metals Exploration Company,* financed by Harry Paine Whitney, took over the Idaho-Maryland Mines Company holdings, which comprised a former consolidation known as *Gold Point Group.* Work was begun on the Idaho-Maryland by unwatering the shaft which was 1000 feet deep at the time. Below this, the old lower workings had been reached by the Canyon shaft (winze) starting 350 feet east of the bottom of Idaho shaft and extending diagonally down the vein to 1600-ft. level,

where another drift northeast 1600 feet led to the collar of the Dorsey winze, which was sunk to the 1900-ft. level. All these workings were reclaimed. The main shaft was sunk 1000 feet and 2000-ft. and 2100-ft. drifts run, as well as much other drifting including drifts from the bottom of the Dorsey winze. The main shaft is 2850 feet long, or 2000 feet deep vertically and the '30' winze is sunk 850 feet below the 2000-ft. level. The Eureka workings were also examined as it had been stated there was considerable $10 ore left there but this was not found. The 20-stamp mill at the Union Hill mine was moved to the Idaho-Maryland and about $300,000 was produced, which was only a small part of the money expended in the work. This company produced $260,000 in 1924 and 1925 and quit work in the latter year.

Mac Boyle, who had promoted the original consolidation, and his associates at this time formed the holding company and took over the property, as they felt the prospecting had not been done to the best advantage. Starting first with a crew of tributers, the nature of developments was soon encouraging enough to permit operation on company account entirely.

Mine Workings and Geology.

On the 1900-ft. level, about 400 feet east of the Dorsey winze, the Dorsey link vein comes close to the '1950' vein which here is only about 10 feet in the footwall of the Dorsey vein; but below they join. Just west of this it is said about $300,000 was taken out in the block of ground between the Idaho and '1950' veins, on the Dorsey link vein between the 2000-ft. and 1700-ft. levels, about 300 feet on the dip. From the 1900-ft. level on the '1950' vein ore was stoped from one foot to 12 feet thick for a stope length of 100 feet to above the 1750-ft. level. Some of this was 'high grade' and much of it $12 ore. About 100 feet farther in the footwall of the '1950' vein the junction of the '1900' and '89' veins was struck and is said to have paid well. In the west face on the '1900' vein there is six inches to one foot of ribbon quartz. This '1900' vein has been opened from there eastward for 1015 feet and is claimed by the manager and superintendent to carry gold the entire distance. The strike of vein is N. 85° W. and dip 45° S. At the east end of this drift a stope was started, showing a perfectly smooth diabase hanging wall. The diabase in the mine workings has been generally in the form of a dike, 20 to 30 feet thick. The footwall is serpentine. At a height of 65 feet above the level, a fault throws the upper section of the vein 42 feet north into the footwall. Here the vein is from 28 inches to three feet thick. The fault is nearly flat looking north, and dips at a low angle east, coming down to the 1900-ft. level near the east face. No. 3 raise, from the 1900- to 1600-ft level 180 feet from the east face, with 550 feet of drifting at 1600-ft. level, shows the vein all the way of good width above the fault and as much as seven feet wide in one face.

The 1900 intermediate level is 70 feet above the 1900-ft. level and was 1000 feet long on April 18. No. 1 intermediate raise, 260 feet west of No. 3 raise, shows the vein five feet wide, with distinct ribbon structure, sulphides and visible free gold, above the 1600-ft. level. Other raises are being put up. All this work for over 1000 feet on the 1900-ft. level and the raises and levels connecting above is in new territory

opened by the present company and makes the outlook for the property highly encouraging, as attractive possibilities exist for the upward extension of this ore which lies in ground farther east than that previously exploited, and said to be virgin to the surface.[1] This too without counting the possibilities of the Morehouse vein, to be mentioned later.

The history of the Idaho-Maryland, as well as that of other mines in the district, makes us realize that geologists and engineers must approach deep mining with open minds. The variable conditions under which ore may occur are so numerous and so little understood that prospecting work which may appear to a conservative engineer as too expensive to be justified is often necessary, if the full possibilities are to be realized.

About 1000 feet east of the main shaft a winze has been sunk on the Morehouse vein to a depth of 270 feet on the dip below the 2000-ft. level. This vein strikes nearly north and dips east, and is so named because it is believed to be the same vein which outcrops on the Morehouse claim, 2000 feet west of the Idaho shaft. A stope has been opened off a level driven from this winze and ore has been stoped for a length of 285 feet. This vein is of good width, having a maximum thickness of 13 feet and carrying a good grade of ore, some of it showing free gold. This ore is near an intersection. This vein also is largely unprospected from here to the surface except for a section from which $80,000 was produced.

The rhombohedral theory is favored now as one that seems to best explain the occurrence of ore here. The blocks of ground formed, if this theory is right, have moved horizontally and vertically. The result is a series of overlapping vein segments, connected by stringer leads or link veins occupying the broken ground at the junction of two blocks, like the Dorsey vein. Narrow quartz veins leading from one side of a block to the other may be indicators and are called 'flow seams.' The link vein is typically an irregular stringer lead because the area it occupies has been twisted and broken probably by repeated movement. The 'flowseam' is a straight narrow vein of quartz occupying a joint or bedding plane with early limited pyrite impregnation of the immediate walls and little or no movement since. The diabase of the hanging wall is in places serpentinized. The serpentine footwall is now believed to be a relatively narrow layer, rather than the extensive body heretofore supposed. The workings of the Idaho-Maryland are in the diabase or along the serpentine-diabase contact and there are no data as to the depth where the grandiorite (quartz-monzonite) may be entered. The fault bounding the Empire vein on the north appears to divide the district into two parts, with the steep north slope of the granodiorite batholith passing at probably great depth below the Idaho-Maryland, as compared with its upper slope in other nearby mines.

Ore Deposition and Mineralogy.

There is evidence visible even to the naked eye and to the hand lens that the principal veins on which ore is now being mined have been the loci of repeated movement and that there have been different

[1] On April 18, after the above was written, the No. 3 raise was 150 feet above the 1600-ft. level and showed over 7 feet of quartz in the top, according to the superintendent. This was 400 feet above the 1900-ft. level.

periods of mineralization. In a hand specimen from the Morehouse 300 stope, the primary quartz making up two-thirds of the sample is white and shows a few bits of included wall rocks and flecks of greenish micaceous mineral, probably mariposite. It is sparingly mineralized with pyrite with a very little gold precipitated upon it, a little galena and possibly telluride. The inner band of a series of ribboned layers, about one inch thick in all, marks the course of metal bearing solutions during the period of maximum mineralization. Pyrite was plentifully deposited in coarse crystals along this former surface, penetrating the quartz to a depth of not over one-half inch. Small crystals of gold were later deposited upon the surfaces of the pyrite, showing plainly on the striated faces but not visibly penetrating the crystals. Small amounts of galena and possibly of telluride (the patches of this too small for removal and test) favor this particular band. The outer ribbons of quartz, showing finely ground gouge of the wall rock in the ribbon planes, show little or no sulphide or gold. The innermost band was obviously the wall of a conduit followed by the gold-bearing solution at the time of principal mineralization. The same conditions would have been repeated along any crack open in the other sections of the vein or along the other wall at the time of mineralization.

A sample from the 16 Intermediate raise West, on the 1900 vein, shows a similar predominance of pyrite in the inner section followed by chalcopyrite, galena and gold. In this place, however, there has been movement since the deposition of the pyrite with crushing of the latter and the inclusion in the vein of many broken fragments of wall rock.

Another sample reported to come from the east end of the 1900-ft. level, but not taken personally, shows free gold intermingled with patches of a steel-colored mineral which was classified by Frank Sanborn in the Division of Mines laboratory as a telluride, probably either sylvanite or petzite. Though telluride had been previously identified in the concentrate from this mine, this is believed to be the first time the exact location of such ore in the workings has been determined.

The diabase of the hanging wall on the 1900-ft. level is altered near the vein to a rock made up partly of carbonates and partly talcose, similar except for the absence of mariposite to the dolomitic secondary rock in the mines at Alleghany, where it is called blue-jay.

Due to the nature of the serpentine and altered diabase walls and the size and structure of veins, the ground in this mine requires more timber proportionately than other mines in the district. Round pine timbers, cut a few miles from the property, are used.

Results of Mining.

The Idaho-Maryland during the recent operations is not known to have produced any rich pockets of 'high-grade.' Errol Mac Boyle reports the total production since the present company took over the mine has been $510,000. Considering that one-half or more of this was low-grade rock, carrying only $2 to $4 a ton in gold, taken out in the course of development, it can be seen that the ore in the pay shoots has been of very satisfactory grade. During 1929, the reported recovery averaged $9 a ton, and in December, 1929, was said to be $11.93 a ton. Of this, amalgam yielded $10.17 a ton and concentrate

$1.76 a ton of ore. The percentage of concentrate in the ore, based on December returns, was 1¼% with an average value of $155.46 a ton. During the first quarter of 1930, mill-heads are said to have averaged $15 a ton.

The 20-stamp mill is in operation 24 hours daily and crushes 50 to 60 tons a day, having a high discharge and crushing through a screen of 35- to 40-mesh. A total of 70 to 80 men are employed. Present costs are not representative as the mill limits capacity. The amount of ore in the block of new ground opened between the 1600 and 1900 levels is believed by the operators to justify more milling capacity.

Kennebec Mines Consolidated include eight claims adjacent to South Yuba River near the North Columbia road in Secs. 9, 15 and 16, T. 17 N., R. 9 E. Owners, Paine Brothers, Nevada City. Leased with option to C. & R. Chatfield, Nevada City.

The claims, which have been held by the owners for 13 years with less than $2,000 production, cover the steep canyon side rising from the river. An adit 355 feet long gives 125 feet of backs below the top of the ridge, crossing two branching veins. Gold occurs in a stringer lead reported to vary from six feet wide with a value of $4 a ton to four feet wide carrying $9 a ton in a shaft 55 feet deep. Additional backs of several hundred feet might be had by running an adit from near the river.

There is a tramway 800 feet long and a 5-ft. Huntington mill which had not yet been erected early in 1930. The owners think it may be possible to work even lower grade ore than that indicated by assays here, by using water power to run the mill and mining by open cut or caving.

Murchie Mine. American Foundation Company, lessees. M. C. C. Van Loben Sels owns controlling interest. O. McCraney, general manager. It is two miles east of Nevada City.

It lay idle from 1915 to April 2, 1928, when the above company began unwatering it. The former operations were described in the Thirteenth Report and in 'Mines and Mineral Resources of Nevada County,' 1918. The mine was completely dewatered by August 8, 1928. Surface buildings and electric equipment were added. A drain tunnel 658 feet long was run, connecting with the shaft at a depth of 185 feet. The shaft, which is vertical to a depth of 400 feet and thence an incline to 1150 feet, was retimbered to a depth of 140 feet.

While some good ore was found in the lower levels, the tonnages were so small that O. McCraney, who became manager in September, 1929, advised the immediate sinking of the shaft. A winze then being sunk from the 1150-ft. level was showing good ore 10 feet wide which was reported to have a length of 115 feet on that level. Raises were being put up on several small orebodies. Shaft sinking was started in the fall of 1929, and early in 1930 had passed 1250 feet.

When the property was visited in September, 1929, the mill was being operated two shifts and was handling from fifty to sixty tons daily on the average. Ore from the twenty stamps is classified, the fines going direct to six Kraut rougher flotation cells and oversize to tube mill for fine grinding, then to rougher cells, and to two finisher cells. Flotation reagents used per ton are: CaO, 1.0 lb.; Zanthate, 0.15

lb.; $CuSO_4$, 0.40 lb.; Aerofloat, 0.15 lb.; cresylic acid, according to conditions; pine oil, according to conditions.

The ore carries free gold, pyrite, galena, sphalerite and small amounts of gold and silver tellurides. The percentage of concentrate ranges from a little less than 2% to 2½% and the daily product at time of visit was running from 1.7 to 2 tons, of a value of over $250 a ton.

The mine plant includes a 19″ by 14″ air compressor, operated by 150-h.p. motor, a double-drum electric hoist, drill sharpener, oil-fired forge and a three-rail two-car gravity tram of 1-ton capacity from the headframe to the mill. Sixty-two men were employed.

Mystery Prospect is northwest of Grass Valley and is near the west side of the large acreage in part owned and in part under option to Cooley Butler, Los Angeles. Other properties are the *Black Bear, Golden Center, Alta Hill* and contiguous holdings covering a nearly continuous strip almost five miles long and containing about 4700 acres. L. S. Wincipaw, manager.

The Mystery has a shaft 200 feet deep on 45° incline, and with drifts east and west on the 100-ft. and 200-ft. levels. In all, 1500 feet of underground work has been done. A vein of low-grade quartz 4 to 4½ feet wide was followed. It strikes west and lies between two veins striking north. The longest drive was 400 feet west on the 100-ft. level. No underground work has been done since stormy weather set in this winter, and workings had partly filled with water when the place was visited February 12, 1930. Country rock is the usual greenstone of the district.

Equipment includes hoist and air compressor operated from a 25-h.p. Diesel engine; and 5-stamp mill and 2-unit Huelsdonk concentrator with 15-h.p. engine.

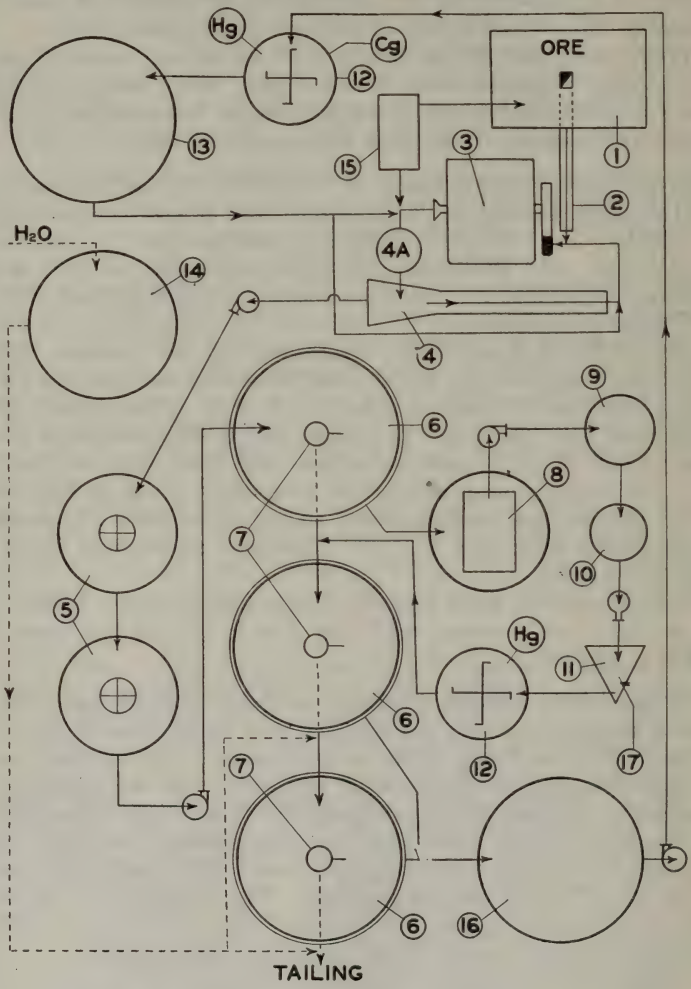
New England Consolidated Mines at Gold Flat, Banner Mountain and Forest Springs are idle but the new mill on the New England Mine near Town Talk is being used as a custom mill, treating ore and concentrate brought in from small properties in the district. It is an all-sliming cyanide plant of about 50 tons daily capacity. The special features of the plant are the Vandercook Mercuric Cyanide System and the Bradley automatic valves. The ball mill discharge is kept as near 75% solids as possible. The function of the Bradley valve is to discharge automatically from the thickeners a pulp containing 55% to 60% solids when handling concentrates.

The Vandercook Mercuric Generator, of which there are two in the mill circuit (see No. 12 on accompanying flow sheet) is a wooden tank with a saucer-shaped layer of cement over the bottom. In this saucer about 50 lb. of mercury is placed. By means of a tee connection on the pipe delivering cyanide solution to the generator, air is sucked into the stream to aerate the solution, which is discharged directly upon the mercury forming, according to the inventor, mercuric cyanide. It is claimed that the presence of mercuric cyanide shortens the time of treatment and makes possible the treatment of complex ores containing sulphides which would foul an ordinary cyanide solution, because the mercury in the mercuric cyanide is presumed to combine with the sulphur in alkaline sulphides present. In the New England plant the time of treatment is said to be only 21 hours. The Mercuric

FLOW SHEET

NEW ENGLAND CONSOLIDATED PILOT MILL

BY COURTESY OF FRED. E. NETTELL, SUPT.



1 ORE BIN
2 CONVEYOR-FEEDER
3 MARCY BALL MILL
4 CLASSIFIER
4A EMULSIFIER
5 AGITATORS (2)
6 VANDERCOOK THICKENERS (3)
7 BRADLEY AUTO VALVES (3)
8 CLARIFIER
9 INDICATOR TANK
10 ZINC CONE
11 PRECIPITATE PRESS
12 VANDERCOOK MERCURIC GENERATORS (2)
13 SOL. STOCK TANK
14 WATER SUPPLY
15 LIME FEEDER
16 SOL. SUMP TANK
17 BULLION FURNACE

Generator was also installed in the North Star Mines cyanide plant at Grass Valley and according to a statement by Irving W. Carson, cyanide foreman, it "increased the extraction, shortened the time of treatment and removed soluble sulphides from the solution which is evident by the removal of base matter in our bullion."

Newtown Mining Company (includes *Mulcahy Mine*) owns 420 acres in Secs. 8 and 17, T. 16 N., R. 8 E., four miles west of Nevada City. In 1920 an inclined shaft was started and was finally sunk 200 feet on the vein and about 300 feet of drifting was done. The vein is reported to be two to three feet wide and carries bunches of sulphides of good grade in places. A 10-stamp mill was put on the property and was operated for about 60 days in 1923 but the returns were disappointing. No work has been done since 1923. Inefficient milling and lack of finances to continue prospecting have been blamed for the failure of the property to come up to expectations.

Normandy Gold Mining Company (Normandie Dulmaine). c/o A. B. Greenwald, 1005 South Grand avenue, Los Angeles. Property is $4\frac{3}{4}$ miles from Grass Valley and near the Alcalde in Deadman's Flat district. It has been worked in a small way at intervals since the days of placer mining, when the surface placers, derived from the erosion of the veins, paid well. Small bodies of 'high-grade' or 'specimen' ore were taken out down to a depth of 110 feet previous to 1900. Little work was done thereafter until about 1921 when the above company was formed and began shaft sinking. The shaft had reached a depth of 250 feet in 1922 and in 1924 had been sunk to 350 feet. Levels were turned at depths of 130 feet and 300 feet, with short drifts on each. Work continued at times up to 1928 with a small crew.

The vein stands nearly vertically in amphibolite schist walls. In the upper part of the shaft and the first level, the fissure is about the width of the shaft and the quartz vein is 12 to 18 inches wide, and showed some sulphides. Occasionally small bunches of 'high-grade' were reported in the prospecting, but there is no record of production. Equipment includes a 5-stamp mill, 10″ by 10″ compressor, single-drum hoist and 25-h.p. and 15-h.p. motors.

North Star Mines. This company's Grass Valley property was sold May 1, 1929, to *Newmont Mining Corporation.* Milling of ore was stopped shortly after, and a program of prospecting and development was started. At present an overhead tram is being erected to deliver ore from the North Star to the Empire mill, it being planned to centralize ore treatment there, and abandon the North Star mill and cyanide plant. During the prospecting program, leases will be let to local miners for blocks of ground in the upper levels.

The past operations at the North Star and the geology of the mine down to the 6300-ft level have been covered in numerous publications, of which a list is appended. The accompanying table, 'Production of North Star Mines, 1914–1928, inclusive,' summarizes those most important and interesting details, the tonnage and value of ore milled and the cost of operation, as shown in the company's annual reports. In order to give the reader a comprehensive picture of the entire history of the mine so that he can make comparisons and draw conclusions

for himself, some previously published data relative to operations between 1851 and 1914 are given.

The total production of North Star Mines (Grass Valley holdings) from the date of discovery in 1851 to the end of 1928 was $33,267,734, which may be divided as follows to show results in the different depth zones. Here it should be noted that the itemized figures next shown are entirely for production from the North Star vein up to the end of 1914. At that time, in sinking the inclined shaft, the junction of the North Star vein and the No. 1 (or X) vein was encountered at the 6300-ft. level and the North Star vein was not found beyond the intersection.[1] This vein produced little ore below the 5300-ft. level. Up to January, 1918, no stoping had been done below the 4400-ft. level. During the next five years, to the end of 1922, the bulk of ore remaining available in the North Star vein was worked. No. 1 vein had about 900 feet of backs above the 6300-ft. level within the property lines (a compromise boundary) and another vein, found later and called No. 2, died out about 800 feet above the 6300-ft. level.[2]

The North Star vein, according to Wm. Hague, produced $16,715,000 from 1,170,000 tons of ore up to the end of 1913. The production by years, between 1914 and 1928, inclusive, is shown on the second table herewith.

AVERAGE VALUE OF ORE AT VARIOUS DEPTHS, NORTH STAR MINES

Dates	Depth (on dip)	Tons milled	Average value per ton
1854 (8 months)	42 ft.	4,160	$18 00
1855 (8 months)	144 ft.	4,000	25 00
1852 to 1866	750 ft.	[4]60,000	25 00
1868 to 1869		11,000	30 00
Year to October, 1870		7,834	21 37
1867 to 1875	1200 ft.	50,000	22 50
Mine idle from 1875 to 1884			
1884 to 1913[1]	1,200 to 2,700 ft.	328,000	16 44
1901 to 1913[2]	3,000 to 4,400 ft.	732,000	11 87
1914 to 1918[3]	3,000 to 4,400 ft.	428,940	10 52
1918 to 1928	4,400 to 8,700 ft.	1,060,501	8 74

[1] So-called upper mine operations.
[2] So-called lower mine operations.
[3] See accompanying detailed table showing yearly production and values for period 1914 to 1928, inclusive.
[4] Estimated total.

The other mines which were consolidated with the North Star over a long period of years were producers in some cases both before and after purchase. Massachusetts Hill vein with a width of one to two feet, was credited in old reports with an output of $3,000,000 previous to 1870 and between 1894 and 1900 the mine of this name produced about $1,000,000 under the North Star ownership. The Gold Hill Mine, with a vein averaging about one foot wide, but irregular in size, course and tenor and carrying rich pockets, was the first opened in the camp and is supposed to have produced about $4,000,000. Lindgren thinks these veins are the same. New York Hill vein has produced about $1,000,000.

[1] Foote, Arthur B. Technical Publ. No. 324, Trans. A. I. M. & M. E., 1929.
[2] Opus cit.

PRODUCTION OF NORTH STAR MINES, 1914 TO 1928, INCLUSIVE

Year	Tons crushed	Yield per ton	Gross output, dollars	Operating cost per ton milled including part of development cost	Profit or loss per ton	Approximate depth on dip of ore mined
1914	107,250	$10 40	$1,115,586	$5 43	$4 97P	above 4,400
1915	109,860	9 92	1,089,751	5 73	4 19P	
1916	111,330	10 42	1,160,007	6 26	4 16P	
1917	100,500	11 43	1,148,685	6 70	4 73P	
1918	99,550	7 79	775,688	*7 80	----------	3,400 to 5,500
1919	102,800	8 95	917,999	*7 94	[4]1 30L	
1920	61,400	11 70	718,286	[1]10 51	----------	
1921	76,000	[3]12 14	922,769	[2]11 60 [2]10 50		
1922	115,600	9 41	1,087,706	8 13	1 28P	above 6,300
1923	89,500	8 28	741,336	9 29	1 01L	
1924	109,200	7 98	871,416	8 60	0 62L	
1925	94,600	8 19	774,941	8 54	0 35L	6,000 to 6,600
1926	94,600	7 86	743,047	9 01	1 15L	6,000 to 7,500
1927	108,651	8 11	881,319	8 40	0 29L	6,600 to 8,600
1928	108,600	7 70	836,567	8 21	0 51L	6,900 to 8,700

*No development work done in 1918 and little in 1919. Cost of producing one dollar in gold during various years was as follows: Average for 5 years 1912–1916, $0.54; for 1922, $0.865; for 8 years 1917–1925, $0.98.

[1] During last half of 1920, running 20 stamps, operating and development cost was $13.38 a ton.

[2] During first half 1921, work at one-half capacity, cost $11.60 a ton.

[3] Selected ore.

[4] Total loss including depletion and depreciation, $134,000.

Geology.

The geology of the Grass Valley district has already been discussed at the beginning of the section on gold quartz mines and in the articles on the Empire and Idaho-Maryland mines. Only a few points remain to be emphasized. Perhaps the first of these was the frequent occurrence in past years of small bodies of very rich ore or 'high-grade' in the North Star and Empire upper workings. Often a small and unpromising vein would be followed hundreds of feet because the operators felt it would lead to enrichments. The conviction, born of long experience, that such enrichments could be relied upon, often led to extensive underground work, that would seem unwarranted to the engineer who lacked experience in the district and based an opinion solely on examination of the faces to be prospected. Over a long period, about 35% of ground explored on the veins has proved profitably productive.

The persistence of the veins both in dip and strike, considering their usual narrowness, has been noteworthy. While some of the Mother Lode mines exceed the North Star and Empire in vertical depth, no other veins in the state have been followed so far on the dip. Even in ore from the deepest levels of the North Star, most of the gold is free. In 1926, 68.98% of gold was recovered by amalgamation and 31.02% by cyanidation. In 1927, 70.16% was amalgamated and 29.84% had by cyanidation. In 1928 the proportions were 78.11% saved in amalgam and 21.89% by cyanidation. This ore came from depths between 6900 and 8600 feet on the dip.

The average width of the veins in the North Star was 16 inches and the average width of stopes was 42 inches. In contrast, the No. 1 or 'X' vein, found at the 6300-ft. level, is a fault vein consisting of 30 feet or more in width of crushed material without well defined walls, containing bodies of quartz distributed irregularly in the vein filling, and with some open spaces full of water. No. 2 vein, also found in the deeper levels, is small and with hard walls. Still another vein, called No. 3, was prospected in the deepest zone worked, between the 7200- and 8600-ft. levels.

Later Development Program.

When the upper levels of the mine, down to 4000 feet inclined depth, became exhausted, a problem arose in getting the men and supplies expeditiously to the lower workings. The Central vertical shaft connects with the North Star inclined shaft at the 4000-ft. level of the latter and men and supplies had to be transferred there to go below.[1]

It was also found that the North Star vein evidently did not continue below its junction at the 6300-ft. level with the No. 1 or 'X' vein, which dips opposite to the North Star vein. In 1918 stoping began in the ground below 4400 feet. The North Star vein did not produce much below the 5300-ft. level. A new vein called No. 2, which branched from the North Star vein 1200 feet east of the shaft and which strikes north and dips west, was found on the 6300-ft level. However, the possible tonnage on both No. 1 and No. 2 veins above the 6300-ft. level did not promise a sufficient ore reserve. It therefore became necessary to plan for developing the mine below the 6300-ft. level.

The project as finally adopted included the deepening of the Central shaft nearly 2000 feet vertically where it was expected to cut the No. 1 vein, and the simultaneous sinking of two inclined winzes on No. 1 and No. 2 veins. The first was to be in line with the North Star inclined shaft, but as No. 1 vein was dipping in the opposite direction it was estimated that this winze would have to be sunk 2300 feet from the 6300-ft. level to bring it directly under the Central vertical shaft. The No. 2 inclined shaft was to be sunk from the 6000-ft level at a point 2700 feet southeast of the 6000-ft. station on the North Star vein, and was to be connected with the two other shafts on the 8600-ft level.

The work of carrying out this extensive program has been described by Arthur B. Foote in the paper cited, *ante*. The 8600-ft. level was extended east from the bottom of the vertical shaft a distance of 1743 feet and was connected with the bottom of No. 2 shaft by a raise of 300 feet, completing the project in November, 1927. The vertical shaft then had a vertical depth of about 3600 feet.

In 1928, a total of 10,458 feet of development work was done in the deeper levels, including 6637 feet of drifts and 3431 of raises. Of this, 3583 feet was on the 'X' vein, 4717 feet on No. 2 vein and 2158 feet on No. 3 vein, between the 6600-ft. and 8700-ft. levels.

Mining Methods.

The manner of mining has been evolved to fit the existing conditions, which are different from those in other Californian districts. The veins are generally so flat (about 26° dip) that rock will not run. Levels

[1] Foote, Arthur B. Vertical and Incline Shaft Sinking at North Star Mine, A. I. M. & M. E. Tech. Paper 324, Oct. 1929.

in later years have been run 300 feet apart and as shoveling was slow and expensive from the upper part of stopes, scrapers have been used where possible to drag ore from the faces, collecting it at a temporary track where it was dropped by a 'go-devil' to the level below. The temporary track was kept about 60 feet below the working face. The coarsest waste was sorted out underground and used for back-filling stopes. It was found by tests underground that the smallest size that could be sorted there was six inches in diameter. The smaller waste was therefore sent on top, where it was removed in a sorting plant in the headframe. (See *post.*) The floors of stopes were swept before leaving them.

Little timbering was ever required in the mine (aside from shaft sets) until sinking began on the 'X' vein. The walls are hard generally and the vein sometimes frozen. Branching veinlets, irregular orebodies and the practice of getting as much of the stringer ore as practicable made for uneven floors in the stopes. A few stulls were used in stopes and some timber to keep from blasting ore from the face down past the temporary track or into the main levels. The gathering of ore for hoisting to the surface was done mostly by mules, hauling 18-cu. ft. side-dump cars. The tendency was to carry a number of small stopes rather than a few large ones, as this made for better working conditions. For men in the stopes, production was 0.95 ton per miner per hour, and for the entire crew, above and below ground, 0.163 ton per hour per man. For blasting, 35% or 40% gelatin dynamite was used and the average consumption was $1\frac{3}{4}$ lb. per ton for operation and development. Of the total labor pay roll, about 89% was underground labor, and the cost of this mining labor made up 60% to 65% of mining cost. One foot of development work on the North Star vein usually made available 20 to 25 tons of ore.

Pumping.

Electric power for pumping is supplied through two sets of lead-covered cables, one going down the entire length of the vertical shaft, the other down the same shaft to the 4000-ft. level, then down the North Star and No. 1 inclined shafts. Separate sets of pumps are provided so that in case of accident in the vertical shaft, water can be pumped out through the inclines. Ordinarily, water from the 8600-ft. level is pumped in one lift of 1920 feet to the 4000-ft. level. There is less water in the deeper levels than above, and the pumps on levels between 6300 and 8600 feet run as a rule only a short time daily. At the 4000-ft. station are two 10-stage turbine pumps with a capacity of 400 g.p.m. each, and a 5-throw plunger pump, capacity 550 g.p.m. For emergency, air pumps are provided on various levels. A Cornish pump installed in the eighties and operated by water power handled the water from the upper 2400 feet of workings.

Hoisting, Compressors, Electric Power.

The main hoist is a Nordberg duplex air hoist with Nordberg cut-off, drums nine feet in diameter and six feet face. The rope speed is 1200 feet per minute and load capacity is four tons of ore in addition to the 5000-lb. skip and cable, to an inclined depth of 7300 feet. The main compressor has a capacity of 2310 cu. ft. of free air a minute and there are two others of 1200 cu. ft. capacity each, and one of 900

cu. ft. capacity. According to Arthur B. Foote the total air consumption per ton hoisted was 11,100 cu. ft. of free air, of which 3300 cu. ft. was for hoisting, 5600 cu. ft. for drilling and 2200 cu. ft. for ventilation. Electric power costs 0.9 cent per k.w.h. and about 3½ h.p. was consumed daily for each ton mined and milled.

Sorting.

Hand sorting was started about 1916 in a plant attached to the ore bins in the headframe. A crew of eight men and a foreman were employed. The ore was washed as it passed onto the sorting table and close work was possible. From one-fourth to one-sixth of the total tonnage hoisted was thus disposed of as waste at a great saving, as the gold value in rejected rock plus the sorting cost was generally far less than the cost of treatment. In 1918 on an average run of 6½ hours daily, each man averaged 12½ tons of waste sorted.

Assaying, Milling, Recovery.

On account of the erratic distribution of free gold in the ores, and the occurrence of specimen ore, assaying is not carried on as extensively at the Grass Valley mines as in many camps. Estimates of daily production are often made by keeping a record of quicksilver fed in the stamp-mill and of solution precipitated in the cyanide plant (with assay of the latter) rather than by sampling millheads. Tailing is sampled daily.

The milling system has been previously described and as the mill is closed down, the reader is referred to the report made in 1918 for details. The sixty 1500-lb. stamps crushed the ore to about 20 mesh, and it passed over plates. After concentrating the pulp and grinding the concentrate in a pebble mill the latter was run over a plate to recover gold released by the fine grinding. The entire mill tonnage then was cyanided. This mill handled 300 tons daily and the reported recovery was very good. In 1914, with ore of an average value of $10.40 a ton, tailing was reported worth only 30½ cents a ton, indicating over 97% recovery. In 1926, the tailing loss was 37 cents a ton, with ore averaging $7.86 a ton, and in 1928, the estimated tailing loss was 29 cents a ton with ore worth $7.70 a ton.

Costs.

Total costs are shown for each year in the production table. Detailed costs have not been sought for the past few years by the writer as it was felt that these would not be representative because of the unusual conditions existing during the deep development program. Total costs shown here varied a great deal over the 15-year period covered in the tabulation. Between 1914 and 1917 the total mining cost jumped from $3.043 to $4.629 a ton but milling and cyaniding increased little, in spite of increased labor and material costs, as the consolidated milling in the new mill resulted in a big saving. In 1918 there was no development work done and little in 1919 because of shortage of good miners and lack of efficiency in those available. Wages for miners increased from $3 a shift in 1913-14 to $4.75 a shift in 1918-19 and this was reflected in the increase in mining cost. In the last half of 1920 and first half of 1921, costs soared as a result of working at one-third to one-half capacity on selected ore. In July, 1921, work was suspended

for several weeks pending agreement on a reduced wage scale. This and reduced cost of supplies made possible a reduction of over $1 a ton in cost in 1922. The cost of labor has been from 60% to 65% of total cost for a long time. The year 1922 may be taken as about the latest in which costs were at all representative. The operating cost then was $6.99 a ton and development cost $1.14 a ton. Some items may be compared with those for 1913 and 1917:

Comparison of Items of Costs 1913, 1917 and 1922

Item (per ton crushed)	*1913*	*1917*	*1922*
Development	$0 60		$1 14
Breaking rock (mining)	87	$1 12	97 [1]
Hoisting	209	18	36 [2]
Pumping	204	19	36 [2]
Taxes	25	272	316
Tailing disposal	00	028	10

[1] Computed as 20.83% of 57.5% of a total cost of $8.13.
[2] Estimate by Arthur B. Foote.

Shoveling rock required about the same number of shifts for a given tonnage as breaking rock, but at lower wages. Development work in 1922, at a cost nearly double that of 1913, was found to be insufficient, and the amount in later years was raised to $1.47 a ton.

As the North Star was one of the two principal sources of tax revenue of the county in late years, this company felt severely the increased burden of taxation. In earlier years the company enjoyed a low electric power rate under a long-time contract. This contract was set aside by the State Railroad Commission, resulting in an increase of about 33% in cost of power, including the state tax which is levied on public utilities and passed on by them to consumers. In 1921 the assessed valuation of the property was $551,835 and the total tax paid was $25,542, amounting to nearly 34 cents a ton crushed. In 1917 the California Debris Commission (a federal body) gave the company notice that they must quit dumping tailing in the creek, as had been done since the earliest operations. A capital outlay of $27,000 and a further cost of 10 cents a ton was incurred in following out this order.

Pioneer Mine (Mitchell Ranch Mine). C. C. Mitchell et al., owners. Pioneer Gold Mines Company, lessee, with option to purchase. Frank Lassen, president, and George R. Gibson, secretary, 1100 San Antonio avenue, Alameda. Options cover 160 acres, 80 acres of which are for mineral rights only, on property two miles east of Grass Valley.

Mitchell produced some gold by ground-sluicing and mined five tons of surface ore in 1923 that yielded $250. A company of local men formed the Pioneer Mining Company in 1925, sank the shaft to 70 feet and opened a level there on the north from which some oxidized ore of low grade was milled. The present company has had the property about two years. The shaft has been sunk 170 feet, and at the 170-ft. level a crosscut of 123 feet has been run, striking a small vein which varies in width from a seam up to 14 inches in the accessible part of this level. At a point 233 feet northwest of the shaft this level is closed by a bulkhead to hold back the water. Forty feet back from the bulkhead, a winze has been sunk 120 feet on the vein which in this distance widens from a seam at the level to one foot on the north and two feet at the south in the bottom. On the 170-ft. level just past the winze the vein opens into a lens 25 feet long and here good ore was reported. Beyond the bulkhead the vein is reported larger.

The total length run on 170-ft. level is reported to be 260 feet. The gold is said to be erratically distributed, giving assays varying from $2 to $57 a ton. Good values are reported in the winze and the section of vein behind the bulkhead is also said to be promising.

The surface shows two series of parallel veins, one set striking nearly east and west, and the other series, on one of which the shaft was started, striking N. 33° W. Whether the vein on which the 170-ft. level is run is the same as that in the 70-ft level is not certain. The country rock is diorite. The vein carries some pyrite and smaller amounts of chalcopyrite and galena. Scheelite occurs in bunches in places on the 170-ft. level.

The equipment consists of a small hoist, air compressor, and pump, all operated by small gasoline engines. About 75 g.p.m. of water are pumped. A larger pump is needed to handle the water now shut off by the bulkhead. It is also planned to install electric power and a larger compressor. No work was being done at time of visit April 18, 1930.

Queen Lil Mine (Buffington Mine) is a little more than a mile from Nevada City, beside the state highway to Downieville. It is under lease to *Yellow Tiger Mining Company*. Gordon Bettles, manager, Nevada City. This company has under lease all the *Champion Group* north of Deer Creek, and is prepared to sublease parts of the holdings.

The country rock here is the quartzose and micaceous schist of the Calaveras (Carboniferous) showing nearly vertical schistosity in the mine. The vein is very flat and cuts the planes of schistosity nearly at right angles. It ranges in width from one foot to 18 inches in the wider places, forming small lenses of ribbon quartz carrying considerable pyrite and some galena. Between the lenses the vein pinches down. In the sump it shows a width of over a foot. It is locally believed to be a footwall split from the Wyoming vein. Pay in the past has been found usually in pockets or bunches and the total output is stated by Bettles to have been about $30,000. He hopes to mill ore of an average value of $15 a ton. The property was operated in 1926 by Joe Fontz et al., who made a small production.

Workings include a shaft on a flat incline, and three levels reaching an inclined depth of about 200 feet. A length of about 200 feet on the strike has been prospected. Work is being done on the second and third levels; the latter is opened about 80 feet east and 80 feet west (April 17). Ten men are employed.

There is a 10-stamp mill with concentrators. Five stamps were operating when visited. A 2-drill compressor is operated by a 30-h.p. motor. The hoist has a 15-h.p. motor. The mill and crusher are run by 25-h.p. and 10-h.p. motors. Only about 20 g.p.m. of water is pumped.

Spanish Mine. Owner, Spanish Mining Company and San Francisco Commercial Company, c/o F. W. Bradley, Crocker Building, San Francisco.

The camp and portal of the lowest adit are three miles north of Washington in the canyon of Poorman Creek, but the property extends north for two miles through Secs. 30 and 19, T. 18 N., R. 11 E., including the old Spanish Mine, patented, the 16 to 1, and several unpatented claims. The workings on the north end are mentioned under 'Barite.'

The present workings, at an elevation of 3050 feet (aneroid) are at and near the old 16 to 1 shaft and drifts, which have been reclaimed and are being extended. The 16 to 1 was a small producer of low-grade ore. It was worked by an open pit, a shaft and short drifts and adits. The vein was stoped to a depth of about 85 feet, for a length of nearly 500 feet and up to 20 feet wide. The best ore was reported on the footwall of vein and worth $8 a ton. The previous work was between 1903 and 1906. At the Spanish Mine, where work began in 1883, F. W. Bradley established a record of low cost for mining and milling gold quartz ores. The operations were described in Report VIII of the State Mineralogist, where it is stated the ore averaged $0.70 a ton in gold content. The vein was reported 75 to 90 feet wide, with the pay occurring in the poorly defined hanging wall portion where the soft slate "carried many veinlets and streaks of ferruginous quartz, carrying gold," whereas the solid quartz vein on the footwall did not pay, and was left in place.

The lowest adit which was 2500 feet long when visited in August, 1929, included 800 feet of old work. The formation is black slate, classed as Carboniferous and locally mapped as the Blue Canyon formation. Serpentine lies less than one mile west on the surface. The vein strikes N. 14° W. The Spanish pit is 4000 feet distant from the portal of this adit, and a large barite deposit owned and recently developed by the same people, is 8000 feet away. This adit if extended that far will give 800 feet of backs at the Spanish pit and would be about 1500 feet below the outcrop of the barite deposit which, however, does not extend downward to any such depth as a commercial barite deposit. Along the strike of formations northward from and 300 feet higher than the present work, a raise put up 500 feet from an upper adit showed a vein two feet wide with barite gangue, carrying zinc-blende and bornite, and with some pay in the two feet adjoining in the slate wall. This would be a type of ore not previously mined in the district.

The shaft, 79 feet deep in the old 16 to 1 pit was to be deepened 200 feet to prospect the vein there. An old adit 200 feet long taps this shaft at 79 feet in depth.

The prospects obtained had been such that grading had begun in August, 1929, for a 50-ton mill in which it was planned to use the flotation process, much of the pay being in sulphides. Forty men were employed. An electric power line 10 miles long has been run from Alleghany to the property. About one mile of flume, ditch and double siphon was supplying enough water in August to generate 30 h.p. for operating an air compressor.

Twin Sisters Mining Company, Ray O. Foster, president, Ukiah, continues prospecting its claims in Secs. 12 and 13, T. 18 N., R. 10 E., just south of Middle Yuba River and at the south end of the Alleghany district.

A small crew of men has been employed during the past winter but no strikes of importance have been announced. A little ore of high grade was struck several years ago in the upper adit, 180 feet below the outcrop. For the past three years the company has been running another adit 350 feet lower on the dip, to cut the vein. This adit was

over 1000 feet long in May, 1930, and it was expected the vein would be struck at 1240 feet.

Western Merger Mine (formerly *Randolph*) is in SE¼ Sec. 32, T. 17 N., R. 9 E., three miles from Nevada City on the North Columbia road. Elizabeth K. Davis, owner. It was leased in October, 1926, for five years to A. A. Codd, Reno, and has been prospected by Western Merger Mines Company for the past three years but work had stopped when the property was visited in September, 1929, and it was expected the company would give up the lease.

The principal claim had been prospected a little and there was a good showing in the shaft when the company began work. The shaft was sunk to the 400-ft. level, following the vein with a dip of about 68° N. to 50 feet below the 300-ft level. The 'A' vein, first found, has a curving course east, and the ore was at its intersection with the 'B' vein, the intersection raking northwest. Both walls are granodiorite, hard and with little or no gouge on the vein. The 'C' vein was found 85 feet south of the shaft. It dips north toward the main vein at an angle of about 45°. A total of 5600 feet of drifts, crosscuts and raises were run by the company, largely on the 400-ft. level, where the 'A' vein was followed 1199 feet east and 884 feet west, the 'C' vein was drifted upon 160 feet east and 475 feet west, and the 'D' vein 105 feet east and 123 feet west. The principal stoping was from No. 3 level nearly to the drain tunnel on both sides of the shaft, for a total length of about 100 feet and a height of 65 feet. The ore was from a few inches to a foot thick, averaging ten inches. The quartz of the 'B' vein was dark and glassy with galena and pyrite; that of the 'A' vein much whiter, containing marcasite. The prospects found on No. 4 level were not deemed sufficient by the company to justify further work. The ore milled averaged $15.50 a ton; about 45% of gold was amalgmated and the balance was in concentrate worth $150 a ton, according to Harry B. Skewes, superintendent.

A crosscut was run south 408 feet in search of the Jackson vein which was thought to be parallel in dip and strike to the Randolph 'A' vein. A shaft sunk later on the Jackson vein to a depth of 125 feet showed, however, that it dips south, carrying so far as opened three to eight inches of quartz assaying $10 to $12 a ton between decomposed granodiorite walls.

The mine equipment includes a 22½-h.p. Dillon Box direct connected electric hoist, two air compressors operated by 50-h.p. and 35-h.p. electric motors, drill sharpener, and 60-inch saw with 50-h.p. motor, blacksmith shop and buildings. The mill contains five 1000-lb. stamps, Wheeling crusher and two concentrators.

GOLD (PLACER MINES)

The county still has immense unworked placer resources mostly in deposits that could be worked by the hydraulic process were it not for the question of debris storage. The work of the Hydraulic Mining Commission, and their report to the legislature in 1927 (reprinted in the quarterly, 'Mining in California,' January, 1927) drew attention to these deposits in Nevada County particularly and emphasized the desirability of finding some means of caring for debris so that the wealth locked up in the gravels could be released. While it is true

that by far the greater part of such mining land is in the hands of a few owners, the people of the county as a whole would be benefited by the working of the mines, as a large part of the gold mined would be distributed to the miners for wages and to local merchants for supplies.

The best way to approach the debris problem seems to be to consider it as one part of a combined federal and state water program which should include water storage and regulated flow for irrigation, flood control, electric power generation, and salinity control. The owners of hydraulic mines undoubtedly have a right to full consideration in such a program. In the present state of the art of building dams it is certain that there could be no valid objection to taking care of mining debris behind state dams of the size that would be needed in any comprehensive program for the permanent solution of these other problems. Mining debris would be only a fraction of the total debris caught behind such dams, as natural erosion carries into the streams annually many times the amount that would be produced by working all the hydraulic mines in the drainage of the Sacramento and San Joaquin. The federal government has a moral and express obligation under the act creating the California Debris Commission to mature a plan or plans "with a view of making the same effective as against the encroachment of and damage from debris resulting from mining operations, natural erosion, or other causes * * * and permitting mining by the hydraulic process * * * provided the same can be accomplished without injury to the navigability of said rivers or the lands adjacent thereto."

It seems to the writer that state and federal interests in the waters of these streams are so closely related that all the problems involved can be best and most economically solved by federal and state cooperation in building dams on these streams above the valley, rather than following a policy of trying to control floods and debris after they reach the valley floor.

Deer Creek Placer Mining Company, Box 402, Grass Valley, is prospecting property on Deer Creek in N½ Sec. 15, T. 16 N., R. 8 E. This was formerly held by *International Rare Metals Company,* which made a failure of the project.

In the summer of 1929 the present company installed a plant with a capacity of 30 cubic yards an hour, to test equipment and to determine the value of the ground. A. T. Langstaff reports that from a test run of 1300 cubic yards an average recovery of 20⅞ cents a cubic yard was obtained, but that the bedrock gave pan samples indicating a gold content of several dollars a yard. They are now preparing for the installation of a larger plant.

Eureka and Union Consolidated Gravel Mines are 20 miles northeast of Nevada City in Relief Hill district. The holdings comprise 131 acres, of which 85.6 acres are patented, in S½ Sec. 4 and N½ Sec. 9, T. 17 N., R. 10 E. Under lease and option to W. W. Waggoner and D. E. Bleakley, Nevada City.

The deposit, evidently a south fork of the Derbec Channel and presumably therefore connected with the North Bloomfield deposits, has been worked considerably. From the eastern side the Eagle claim was

hydraulicked from Logan Canyon westward to the boundary of the Eureka claim, then under separate ownership. Eighty acres were worked here, bedrock sloping west. On the Union claim to the west a smaller excavation was made reaching the lowest part of the channel with a sluice tunnel 350 feet long on a grade of six to eight inches in 12 feet, from Union Canyon. The Union tunnel, 2500 feet long, was also run from the west side at a later date and drifting operations through it produced considerable gold. On the east side, the Blue Lead and Waukesha tunnels were run for drifting. The total output of the property is uncertain. A short test run of rim gravel from the north rim, made in 1913, is reported to have indicated about 10 cents gold a cubic yard. The drifting operations were evidently profitable for a number of seasons, indicating good pay on bedrock in the channel. The total output of the camp has been estimated at over $4,000,000.

The gravel forms a flat terrace on the south side of Relief Hill, overlooking the South Yuba River. It fills a pronounced trough in a bedrock of Cape Horn (Carboniferous) slate. The oldest of the gravel is 60 feet deep, coarse and contains little quartz. Above it lie the later runs of sand, fine quartz gravel and clay, having a total thickness of 100 to 200 feet. The material is free washing.

The lessees have been doing repair work and cleaning up preparatory to a resumption of hydraulicking. They propose to clean out the Union sluice tunnel, the 300-ft. bedrock cut, the Irwin ditch and reservoir, relay a 22-inch pipe line and provide an impounding basin for tailing. This proposed impounding basin is the most interesting and important part of the work, so far as the public is concerned, as its successful application means much cheaper tailing storage for hydraulic mines wherever it can be applied.

Union Canyon in which tailing will be dumped, under the plan, is a mile long, with steep sides. Below the mouth of the sluice tunnel is a series of falls with a drop of 600 feet in 800 feet, and a total fall of 1300 feet to the river. From near the foot of the steep stretch first mentioned, the lessees propose to construct a sluice along the side of the canyon to a point below the mouth of a branch canyon. Due to the steep grade of canyon, the sluice will at this point be quite a distance above the bed of the canyon. Here it is proposed to turn the direction of the sluice, crossing the course of the canyon. A grizzly placed at the end of the sluice will screen out the coarse rocks, which will be dumped dry, forming a dam. As the dam reaches the level of grizzly in one spot, it can be extended across the canyon by extending the sluice along its top. While the dam is thus being built, fine tailing can be stored in an old hydraulic pit farther down the canyon. On completion of the dam the water and fine tailing will be dumped in the reservoir formed behind it. The sand and clay, it is believed, will all be retained, some of it at first helping to seal the lower part of the dam so that percolation of nearly clear water will occur through the upper part of dam but no water will run over the top.

The conditions found here which are necessary for the application of this method of tailing storage are: the existence of a dry canyon of sufficient size to form a storage basin, with a bed of sufficient grade to give ample dump room in building the dam; and a place for tailing storage while gravel is being hydraulicked to build the dam.

The water supply for mining comes from the Irwin ditch, with a capacity of 1200 miner's inches. It picks up water from Logan, Roscoe and Deadman's canyons, and might give sufficient water for four months' work, depending on seasonal conditions of rain and snowfall. There is also 2700 feet of 22-inch pipe, 2500 feet of 15-inch pipe, monitors and gates, and dwellings. One of the lessees was engaged in repair work on the property in 1929 and late in the year it was stated that a company was being formed to resume mining.

Grizzly Ridge Mining Company is prospecting the property of the same name four miles north of North Columbia. Philip Toleman, manager.

This property was worked by hydraulicking from 1886 to 1894 then lay idle many years until opened as a drift mine by Mark Alling and others. The exact direction of flow of the ancient channel on these claims has remained in doubt, some believing the inlet was on the Middle Yuba side, others calling this the outlet. The doubt arises on account of the extensive erosion between these holdings and other segments of channel with which it can be correlated, as well as the andesite overburden. The recent work has been by drilling, a series of holes 80 to 90 feet deep having been put down but without conclusive results.

Neocene Gold, Incorporated, was promoted to work the *Loyal Gravel Mine,* location in NW¼ Sec. 1, T. 16 N., R. 8 E., on the north side of Cement Hill. Owners, Andrew Goering, wife and son, Nevada City.

This is an old property which was worked by drifting and hydraulicking in early days. There are at least two old inclined shafts entering the hill where the last work was done. One of these, said by A. Goering to be 600 feet long and to give a depth of 34 feet, has been used as an entry by the last operators. Goering states that in the bottom he struck 'black gravel' carrying $1.50 a ton. At a point 280 feet from the portal and 25 feet vertically lower, a level was turned and over 600 feet of prospect drifts were run south, east and west. The east face, about 205 feet from the main drift, is in granite sand; the west face, about 220 feet from main drift, is in slabby granite. Several raises above this level evidently failed to develop gravel. The work is nearly all in the soft, decomposed granite sand which shows a few layers of clay. It is evidently well up on the rim.

The lessees, having failed to meet a payment due on the property, left the property during the past summer. September 18, 1929, the sheriff levied an attachment against the interests of the company and Charles D. Cline in the equipment on account of wages reported unpaid. There was an Ellis mill, 2 ft. by 6 ft. amalgamator, an 8-h.p. and a 6-h.p. gasoline engine, hoist and three ore cars, and small shop and buildings on the claim when visited in September, 1929.

Omega Placer Mine. Owner, *South Yuba Mining and Development Company,* Charles A. Kaas, secretary, 7 Front street, San Francisco. Lessee, *Omega Hill Mining Corporation.* Charles Moore, president, Yuba City. Theodore Larsen, superintendent. The mine is about four miles by road or trail south of Washington and 9.6 miles from

Emigrant Gap. Elevation 4050 to 4270 feet. Over 1700 acres are included in the holdings.

The early day workings at Omega were rich, claims 100 feet square on the main channel having averaged $8,000 yield each, it is said. About 13,000,000 cubic yards had been mined by hydraulicking before 1915. Since then perhaps 500,000 cubic yards more have been mined. It is estimated that 26,000,000 cubic yards remain. The past average value per yard has been stated at 13½ cents; in recent years runs have given results varying from four cents a yard for the poorest, up to thirty cents a yard. The gravel deposit, which reaches its maximum thickness where the main pipe line descends into the pit, is about 2600 feet wide between rims which here run N. 20° W. From 170 to 175 feet thick here it consists mostly of fine to medium-sized quartz gravel and sand, with some clay in the upper part and boulders of granite near bottom. The bedrock is of schist and soft slate of Carboniferous age.

The basket dam formerly used to store tailing failed in 1919. Recently, under the direction of J. D. Stewart, a concrete dam was put in its place at a cost of $30,000. It is 71 feet high and the main arch is about 105 feet wide. One season's run might finish filling it if no steps were taken to hold debris in the upper part of the canyon. Such a scheme has been devised and it is hoped will be a success. At the foot of the sluices, a grizzly with 3-inch and ¾-inch holes was placed. The coarse cobbles and rocks pass over the grizzly and through a sluice running at right angles directly across the canyon so that when the larger rocks are spilled at different places along the course of this sluice, they form a rock dam. Behind this dam, the sand and smaller gravel which has passed through the grizzly is discharged. Near the upstream end of this dead water and 400 feet from the dam, an upright drain box stands with its mouth high enough to prevent any but the finest suspended matter passing with the water into the drain which was laid below the dam. The trials given this up to the time the property was visited August 23, 1929, showed that the scheme might solve the problem of tailing storage by permitting the holding of all coarse debris in the upper part of the mine, so that only a very small part of the total would go down to fill the concrete dam.

This mine has the second right to water from South Yuba River and claims 5000 inches, this being in conflict in summer with a power company. The larger ditch and flume, totaling 16 miles in length, have a capacity of 5000 inches. The old Omega ditch is eight miles long and has a reported capacity of 1500 inches, taking water from Diamond Creek. Jarman [1] estimated the total available water at 5000 miner's inches for six months and 1200 miner's inches for four months. Theodore Larsen, the superintendent, thinks it possible to run seven to eight months with nearly 5000 inches. The maximum head is about 200 feet. The water should give a rather high average duty, probably in excess of three cubic yards per miner's inch daily. The water supply available would permit resumption of mining on a large scale if the scheme of tailing disposal described proves adequate.

At the time of visit a 30-inch pipe line had been installed from the penstock to the bank on the southeast and from there a 20-inch

[1] Jarman, Arthur, Engineer to the Hydraulic Mining Commission, Report to the Legislature of 1927.

line was being laid across the pit for one-fourth mile westerly, where they plan making a test run on some islands of gravel left standing from former operations. These have a bank 80 feet high, of sand and fine gravel. Another pipe line 2500 feet long was planned. The sluices are 3 feet by 3½ feet with pine block riffles one foot long, used on end. The grade is five inches in 12 feet. There are 1900 feet of sluices with a branch cut 600 feet long. The equipment for storing tailing as mentioned above is at the foot of sluices.

Quaker Hill Gold Mining Corporation has 1458 acres of placer mining ground in Secs. 1, 2, 12, 13 and 24, T. 16 N., R. 9 E., and in Secs. 9, 18 and 19, T. 16 N., R. 10 E., east of Nevada City on an old Tertiary gravel channel. Morton F. Stern is president and Ed. P. Goetz, secretary, 42 Broadway, New York. J. Henry Schnitzel, manager, Lead, South Dakota.

In 1918 and 1919 the company built a camp, brought in electric power and installed machinery for mining and washing gravel. Later they drove over 5000 feet of underground workings. The gravel washed, for the most part was rather low grade to pay for working under present day costs. After mining over 45,000 tons of gravel the company quit work and for the past four years the property has been leased to Botting of Nevada City and has been a small producer.

The equipment installed by the company included a 6½-in. by 12-in. compressor, air drills, two storage battery locomotives, and Price gravel mill with a capacity of ten tons per hour.

The property has been described in past reports of the U. S. Geological Survey and State Mining Bureau. It has been estimated that 35,000,000 cubic yards of gravel has been hydraulicked and several times as much remains, but has been considered unavailable for hydraulic mining due to lack of grade for sluices and dump.

Scotts Flat Mine. Interstate Landholding Company, owner. Scotts Flat Mining Company, c/o Dr. Carl P. Jones, Grass Valley, lessee. J. W. Scott, superintendent. The lessee was preparing in April, 1930, to commence hydraulic mining. A protest had been entered by O. D. Woodman against the granting of a permit. Woodman owns land which he claims would be damaged by tailings from the mine. The property is four to five miles east of Nevada City and tailing would be dumped into Deer Creek behind a dam of the Nevada Irrigation District. A year would be allowed for prospecting, after which it is planned to put in a new hydraulic fill dam.

The deposit has been described in past reports of the State Mining Bureau and U. S. Geological Survey.

You Bet Mining Company, 532 Equitable Building, Denver, Colorado, has extensive holdings in You Bet district which have been worked in a small way since 1915 both by drifting and hydraulicking. At present two lessees are working, preparing to mine small yardages. The present consolidated property includes the Brown's Hill, Neece and West, Walloupa, Nevada, You Bet, Red Dog, Chalk Bluff and Hussey mines.

The property was examined in 1915 by Wm. M. Strong who reported 20,000,000 cubic yards of gravel that will yield 10 to 15 cents a yard.

As the property lies on the ridge between Greenhorn River and Steep Hollow, about 7,500,000 cubic yards would be dumped into Greenhorn River and the balance into Steep Hollow. When the property was hydraulicked in the past, difficulty arose in securing grade for dumping. From 26 rocker samples taken by Strong at Red Dog, an average of 25.8 cents a cubic yard was obtained, and he estimated 3,000,000 cubic yards was available. From 60,000 cubic yards hydraulicked, however, less than $10,000 was recovered. From 45,000 cubic yards mined at Brown's Hill between 1915 and 1920, $10,000, or 22 cents a cubic yard, was saved. F. A. Goodale was in charge of the property between 1915 and 1920 and from his experience and the past record of the mine, estimated there are between 12,000,000 and 24,000,000 cubic yards of gravel that will average 15 to 17 cents a cubic yard. Others believe that much of this gravel will go 20 to 25 cents a yard. Since 1920, these mines have produced a little over $30,000.

The water supply comes from three ditches, two of which head in Steep Hollow, the other in Greenhorn River. They have a total capacity of 3800 miner's inches. In a normal water season it should be possible to pipe for 100 days. The water duty would vary greatly with the part of the deposit being worked. The upper section and rim deposit is of fine quartz gravel with strata of sand and clay, which gives a high duty if sufficient grade is available. In the trough of the channel, for a depth of 30 to 40 feet there is a cemented gravel with some large boulders on bedrock. This section should be tunneled and blasted to break up the cement before piping. This deep ground has been drifted for 1½ miles from the Neece and West ground northeastward. A section of channel three-fourths mile long remains entirely unworked. The gravel is 75 to 200 feet deep in the channel, 90 to 100 feet deep on the benches and up to 400 feet wide. Tailing storage might be provided for by a dam near Wise Bridge, or behind the present Van Giesen dam of the Nevada Irrigation District.

IDLE MINING COMPANIES

Letters of inquiry were sent to a number of mining companies having properties in Nevada County where they have done little or no work in the past ten years, although the companies have maintained their corporate existence and their right to transact business in California as corporations, by paying their corporation franchise taxes.

The following companies answered the letters, stating that no new work had been done since 1920:

Bellefontaine Mining Company. P. O. Box 1102, Sacramento.

Columbia Hill Gold Mining Company. W. G. Morrow, President, 804 Mills Building, San Francisco.

Jenny Lind Mining Company. C. B. Grenfell, Secretary, Grass Valley. (Property under option, April, 1930.)

Jupiter Consolidated Gold Mining Company. W. W. Byrne, Manager, 71 Trinity Place, Portland, Oregon.

North Banner Consolidated Tunnel Company. E. E. Simpson, Secretary, Crocker Building, San Francisco.

Porter Placer Company. (Property sold to Deer Creek Placer Mining Company in 1929.)

St. John Quartz Mining Company. D. E. Matteson, President, Grass Valley.

The following companies formerly doing a mining business in Nevada County were liquidated, withdrew or were suspended for nonpayment of the franchise tax for the year ended March 5, 1929:

Gaston Gold Mining Company.
Grass Valley Boundary Mining Company.
International Rare Metals Recovery Company.
Meadow Lake Mines Consolidated.
New Monte Cristo Mining Company.

MINERAL PAINT

Besides the production of mineral paint at Spenceville (see under Copper, *ante*) there are deposits of possible value near Washington and Colfax, upon which only a little prospecting has been done.

Paine Claims are 2.4 miles from Washington and cover the bedrock of the Alpha hydraulic diggings, long idle. Emigrant Gap, 12½ miles distant, is the nearest railroad point. R. A. Paine, et al., locators, Nevada City.

On the Neva May and Genevieve claims both red and yellow ocher occur. The red material underlies the yellow in many spots over an area 30 feet by 100 feet. No conclusive tests of the quality have been made and no work has been done to determine the amount available.

Steele property is in E½ of Sec. 11, T. 15 N., R. 9 E., containing 80 acres, six miles from Colfax on the You Bet road. Mrs. M. M. Steele, owner, P. O. Box 326, Colfax.

Only a small part of the property, not over 10 acres, is covered by the material which has been tested for paint purposes. The product is of various shades, some of it earthy and friable and resembling sienna and umber in color, and elsewhere a schist or slaty rock impregnated with yellow iron oxide. Tests made at the Northwest Experiment Station of the U. S. Bureau of Mines showed that one of the samples submitted has fair value as a red sienna.

There is no equipment and the work is in the nature of shallow cuts and shafts. There is one good building, which was put up by a company who began work several years ago on the deposit.

SAN FRANCISCO FIELD DIVISION

C. McK. Laizure, Mining Engineer

On account of unfinished field work, there is no report from the San Francisco Field Division in this issue.

LOS ANGELES FIELD DIVISION

W. Burling Tucker, Mining Engineer

On account of unfinished field work, there is no report from the Los Angeles Field Division in this issue.

GEOLOGIC BRANCH

GEOLOGICAL AND ECONOMIC MINERAL SURVEY

OLAF P. JENKINS, Chief Geologist

PREPARATION OF A GEOLOGICAL MAP OF CALIFORNIA

The construction of a new Geological Map of the State of California, to be drawn on the scale of 1:500,000, or about 8 miles to the inch, is one of the principal aims of the Geologic Branch of the Division of Mines. The preparation of this map has already been started and much work has been done to assemble the desired information. The United States Geological Survey at Washington, D. C., is compiling for this map all data which are on file in the federal office. As soon as this part of the compilation has been completed, the progress map will be checked, and additional information from other sources (both published and unpublished) will be placed in some of the areas left blank. Much field work will be necessary to fill in the remainder of the unfinished part of the map.

PLANS FOR GEOLOGICAL FIELD WORK

It is the object of the Geologic Branch to encourage (by paying field expenses so far as possible) research workers in geology in the mapping of areas in the state where geological data are lacking. For the most part, the geologists thus encouraged are working purely as contributors to science, and in many cases they are young men who desire a problem to solve in the winning of an advanced degree from one of our universities. In every case the work represents a high type of scientific endeavor, fundamental to the study of our mineral resources.

Eleven field parties are planned for the coming summer. These are scattered over various parts of the state. In every case the work planned for the summer represents a continuation of past work, or the checking over of mapping, previously left in a more or less incomplete form. A start is thus made and the geological survey may be said to be well under way. The following list summarizes the extent of the plans:

Shasta Quadrangle.

Mr. Chas. V. Averill, District Mining Engineer of the State Division of Mines, Northern California, will complete and check over the areal geology of the Shasta Quadrangle (parts of Siskiyou, Shasta and Trinity counties) contributed by the Geological Department of the Southern Pacific Company.

Weaverville Quadrangle.

Dr. N. E. A. Hinds, Assistant Professor of Geology in the University of California, expects to complete his detailed geological survey of the Weaverville quadrangle located in Trinity and Shasta counties.

Sebastopol and Duncans Mills Quadrangles (U. S. Army Tactical Maps).

Mr. F. S. Johnson, graduate student of the University of California, will continue his geological mapping of the Sebastopol and Duncans Mills quadrangles located in Sonoma County.

Mono County.

Mr. Evans B. Mayo, graduate student of Cornell University, is to continue his geological mapping in Mono County. His work is largely in the Mount Morrison, Mount Lyell and Bridgeport quadrangles.

Madera County.

Mr. Homer D. Erwin, graduate student of the University of California, will be mapping the geology and studying the occurrence of ore deposits in northeastern Madera County. This also includes parts of Mount Lyell and Mount Morrison quadrangles.

Grass Valley.

Mr. R. L. Loofbourow, graduate student of the mining and geological departments of Stanford University, will be studying the geology of the underground workings in the Grass Valley District, located in Nevada County. This work is to be carried on as part of a cooperative arrangement which the Division of Mines is making with the United States Geological Survey.

Searles Lake Quadrangle.

Dr. Carlton D. Hulin, Associate Professor of Geology at the University of California, will continue his geological mapping of the Searles Lake quadrangle located in San Bernardino, Kern and Inyo counties.

Elizabeth Lake Quadrangle.

Mr. Edward C. Simpson, graduate student in geology of the University of California, will continue his geological mapping of the Elizabeth Lake quadrangle located in Kern and Los Angeles counties.

San Jacinto Quadrangle.

Mr. Donald Fraser, graduate student in geology of Columbia University, will continue his geological mapping of the San Jacinto quadrangle located in Riverside County.

San Bernardino County.

Mr. John C. Hazzard and Mr. Dion L. Gardner, both graduate students in geology at the University of California, will make a study of the geology in the Mojave Desert of San Bernardino County. They have compiled material supplied by the Geological Department of the Southern Pacific Company of an area between Daggett and Needles. Mr. Hazzard expects to make a detailed field examination of the Marble Mountains and Mr. Gardner will take as a problem the geology of the Newberry Mountains.

General Geological Work.

A general study will be made in the field of various parts of the state in an endeavor to correlate the geological work which is now in progress. This administrative work and the compilation of various geological maps which have been contributed to the Division of Mines from different sources will be the duty of the Chief Geologist of the Division. A large number of maps in manuscript form cover the Coast Range between San Francisco and Los Angeles. The Northern Coast Range province, however, is lacking in good base maps, and it is this area which will be the most difficult to work. At the present time it is covered by very little geological study.

PREPARATION OF A BIBLIOGRAPHY OF THE GEOLOGY OF CALIFORNIA

A comprehensive volume is to be issued by the Division of Mines, in which will be listed all articles of any importance whatsoever relating to the geology of California, published prior to 1930. This bibliography is being prepared by Dr. Solon Shedd, Custodian of the Branner Memorial Geological Library of Stanford University. Dr. Shedd was for a number of years State Geologist of Washington. He is, therefore, particularly familiar with the geology and the geological literature of the western states.

The bibliography which is nearly completed, represents a very large amount of careful and methodical work. A cross-index is to accompany this book. As a fundamental basis for all researches in geology and as a reference in the exploration and development of the mineral deposits of the state, this bibliography should prove of great value.

LIST OF PUBLICATIONS ON THE GEOLOGY OF CALIFORNIA APPEARING DURING THE EARLY PART OF 1930.

The new bibliography of the geology of California will consist of publications issued prior to 1930. The following list of articles represents those which appeared during the early part of 1930 and is therefore supplemental to the main bibliography.

Publications of the United States Geological Survey, Department of the Interior.

(For sale by the Superintendent of Documents, Washington, D. C.)

Hoots, H. W.
Geology and Oil Resources Along the Southern Border of San Joaquin Valley, California. U. S. Geol. Survey, Bulletin 812–D. Issued March, 1930. (Price 50 cents.)

McGlashan, H. D.
Surface Water Supply of Pacific Slope Basin in Southern California, 1894–1927. U. S. Geol. Survey, Water-Supply Paper 636-E. Issued Jan., 1930. (Price 10 cents.)

McGlashan, H. D.
Surface Water Supply of the San Joaquin River Basin, California, 1895–1927. U. S. Geol. Survey, Water-Supply Paper 636-D. Issued Feb., 1930. (Price 10 cents.)

McGlashan, H. D.
Surface Water Supply of Minor San Francisco Bay, Northern Pacific, and Great Basins in California, 1895–1927. U. S. Geol. Survey, Water-Supply Paper 637-A. Issued April, 1930. (Price 10 cents.)

Schaller, W. T.
Borate Minerals from the Kramer District, Mohave Desert, California. U. S. Geol. Survey, Professional Paper 158-I. Issued March, 1930. (Price 20 cents.)

Topographic Quadrangles.

(Price 10 cents each.)

Famoso (Kern County).
Scale 1 inch-½ mile.
Contour interval, 5 feet.

Porterville (Tulare County).
Scale 1 inch-½ mile.
Contour interval, 5 and 25 feet.

Quincy School (Tulare and Kern counties).
Scale 1 inch-½ mile.
Contour interval, 25 feet.

Richgrove (Tulare and Kern counties).
Scale 1 inch-½ mile.
Contour interval, 5 and 25 feet.

Stone (Tulare and Kern counties).
Scale 1 inch-½ mile.
Contour interval, 5 feet.

Stratford (Kings County).
Scale 1 inch-½ mile.
Contour interval, 5 feet.

PUBLICATIONS OF THE UNIVERSITY OF CALIFORNIA

(University of California Press, Berkeley, California.)

Stauffer, Clinton R.
The Devonian of California. Univ. Cal. Publ., Geol. Sci., vol. 19, no. 4, 1930, pp. 81–118, pls. 10–14. (Price 50 cents.)

Finch, R. H., and Anderson, C. A.
The Quartz Basalt Eruptions of Cinder Cone, Lassen Volcanic National Park, California. Univ. Cal. Publ., Bull. Dept. Geol. Sci., pp. 245–273, 11 fig. in text. (Price 35 cents.)

Stirton, R A.
A New Genus of Soricidae from the Barstow Miocene of California. Univ. Cal. Publ. Bull. Dept. Geol. Sci., vol. 19, no. 8, 1930, pp. 217–228, 2 fig. in article. (Price 25 cents.)

PUBLICATION OF STANFORD UNIVERSITY

(Stanford University Press, Stanford University, California.)

Cushman, Joseph A., and Valentine, William W.
Shallow-Water Foraminifera from the Channel Islands of Southern California. Contrib. Dept. Geol. Stanford Univ., vol. 1, no. 1, Feb. 28, 1930, 51 pp. 10 pls. (Price $1.)

PUBLICATIONS APPEARING IN ECONOMIC GEOLOGY AND THE BULLETIN OF THE SOCIETY OF ECONOMIC GEOLOGISTS

(Prince and Lemon Streets, Lancaster, Pennsylvania.)

Knopf, Adolph, and Anderson, C. R.
The Engels Copper Deposits, California. Econ. Geol., vol. 25, no. 1, Jan.-Feb., 1930, pp. 14–35.

McLoughlin, D. H.
Review—The Mother Lode System of California (Knopf). Econ. Geol., vol. 25, no. 2, March-April, 1930, pp. 225–227.

PUBLICATIONS APPEARING IN THE BULLETIN OF THE AMERICAN ASSOCIATION OF PETROLEUM GEOLOGISTS

(504 Tulsa Building, Tulsa, Oklahoma.)

Henry, Gerard.
McLure Shale of the Coalinga Region, Fresno and Kings counties, California. Bull. Am. Assoc. Pet. Geol., vol. 14, no. 4, April, 1930, pp. 403–410.

Jenkins, Olaf P.
Sandstone Dikes as Conduits for Oil Migration Through Shales. Bull. Am. Assoc. Pet. Geol., vol. 14, no. 4, April, 1930, pp. 411–421.

Reed, R. D.
Small *En Echelon* Fractures in Santa Barbara County, California. Bull. Am. Assoc. Pet. Geol., vol. 14, no. 3, March, 1930, pp. 320–322.

PUBLICATION APPEARING IN THE JOURNAL OF GEOLOGY

(University of Chicago, Illinois.)

Reed, R. D.
Recent Sands of California. Jour. Geol., vol. 38, no. 3, April, May, 1930, pp. 223–245.

PUBLICATIONS APPEARING IN THE AMERICAN MINERALOGIST, JOURNAL OF THE MINERALOGICAL SOCIETY OF AMERICA

(450-454 Ahnaip Street, Menasha, Wisconsin.)

Murphy, F. Mac.
Dumortierite in Riverside County, California. Am. Mineralogist, vol. 15, no. 2, Feb., 1930, pp. 79–80.

Wolff, John E.
Dumortierite from Imperial County, California. Am. Mineralogist, vol. 15, no. 5, May, 1930, pp. 189–193.

Wright, F. E., and Allen, E. T.
Curtisite, a New Organic Mineral from Skaggs Springs, Sonoma County, California. Am. Mineralogist, vol. 15, no. 5, May, 1930, pp. 169–173.

MISCELLANEOUS REFERENCES

(Oil and Mining Periodicals.)

Brown, R. I.
Operations in Kettleman Hills. The Oil and Gas Journal (Tulsa, Oklahoma), vol. 28, no. 46, April 3, 1930, pp. 39, 139–140.

Herold, Stanley C.
Problem of Drainage at Kettleman Hills. The Oil and Gas Journal (Tulsa, Oklahoma), vol. 28, no. 45, March 27, 1930, pp. 40, 146–147.

Morgan, Frank A.
Tideland Development in California. The Oil and Gas Journal (Tulsa, Oklahoma), vol. 28, no. 43, March 13, 1930, pp. 114–122, 243–248.

Stockman, L. P.
Submarine Geology Opens Possibilities. The Oil and Gas Journal (Tulsa, Oklahoma), vol. 28, no. 43, March 13, 1930, p. 132.

Chappius, L. C.
Los Angeles Basin Still Holds Promise of New Discoveries. Petroleum World and Oil Age (1031 S. Broadway, Los Angeles), March, 1930, pp. 67–69.

Chappius, L. C.
Oil Discovery in the Vaqueros Great Boost for Belridge. Petroleum World and Oil Age (1031 S. Broadway, Los Angeles), June, 1930, pp. 70–72.

Herold, Stanley C.
What a Drainage Study Shows of Kettleman Hills' Future. Petroleum World and Oil Age (1031 S. Broadway, Los Angeles), April, 1930, pp. 65–69.

Morgan, Frank A., and Dana, Drexler.
Maricopa Flat—A New Field in an Old Area. Oil Bulletin (California Oil and Gas Assoc., 510 West Sixth Street, Los Angeles), March, 1930, pp. 237, 240.

Parsons, A. T.
Reducing the Hazard of Wildcatting by the Employment of Geophysics. The Record (Associated Oil Company, 79 New Montgomery Street, San Francisco), vol. 11, no. 5, May, 1930, pp. 3–5, 8.

Taff, J. A.
Kettleman Hills Oil Field. The Record (Associated Oil Company, 79 New Montgomery Street, San Francisco), vol. 11, no. 1, January, 1930, pp. 6–9, 14.

Taff, J. A.
Kettleman Hills Oil Field, Part II. The Record (Associated Oil Company, 79 New Montgomery Street, San Francisco), vol. 11, no. 2, February, 1930, pp. 8–10, 15.

Taff, J. A.
Conservation of Oil and Gas in the Kettleman Hills, Part III, Conclusion. The Record (Associated Oil Company, 79 New Montgomery Street, San Francisco), vol. 11, no. 3, March, 1930, pp. 12–14.

Standard Oil Company.
Our Souvenirs of the Pleistocene. Standard Oil Bulletin (Standard Oil Building, San Francisco), vol. 17, no. 9, January, 1930, pp. 3–4.

Standard Oil Company.
We Discover a Mastodon. Standard Oil Bulletin (Standard Oil Building, San Francisco), vol. 18, no. 1, May, 1930, pp. 12–14.

Colony, R. J.
Mining Geology in 1929, Review in Changes of Geologic Thought Concepts of the Origin, Nature, and Structure of Ore Deposits and of Their Field Distribution. Mining and Metallurgy (29 West 39th Street, New York), vol. 11, no. 277, January, 1930, pp. 23–25.

Rieber, Frank.
Choice of Geophysical Methods. Mining and Metallurgy (29 West 39th Street, New York), vol. 11, no. 282, June, 1930, pp. 301–305.

List of Geological Papers Presented in February, 1930, Before the Cordilleran Section of the Geological Society of America

(Abstracts of these papers were published by the Society.)

(Professor Charles P. Berkey, Secretary, Geol. Soc. Am., Columbia Univ., New York City.)

Anderson, Charles A.
Opal Stalactites from a Lava Tube in Northern California.

Anderson, Frank M.
The Kreyenhagen Shales and the Lillis Shale.

Anderson, Frank M.
Age of the Horsetown Beds of California.

Anderson, George H.
Preliminary Report on the Geology of the Northern Half of the White Mountain Quadrangle of California-Nevada.

Bailey, Thomas.
The Eocene Age of the Markley Formation.

Blackwelder, Eliot.
The Landslide Family and Its Relations.

Blackwelder, Eliot.
Pleistocene Lakes of the Basin Range Province.

Blackwelder, Eliot.
Ice As a Rock.

Buwalda, J. P., Gazin, C. L., and Sutherland, J. C.
Frazier Mountain, A Crystalline Overthrust Slab Without Roots, West of Tejon Pass, Southern California.

Byerly, Perry.
The Dispersion of Seismic Waves of the Love Type and the Thickness of the Surface Layer of the Earth under the Pacific.

Church, C. C.
Foraminifera of the Lillis Shale.

Clark, Bruce L.
The Stratigraphic Relationships in the Mt. Diablo Area of the Upper Eocene Deposits to Those of the Oligocene.

Clements, Thomas.
Structure of a Portion of the Southeast Quarter of the Tejon Quadrangle, California.

Crickmay, C. H.
The Geology of Mt. Jura, California.

Cumming, George A.
A Study of the San Andreas Rift and Adjacent Features near Redlands, California.

Davis, W. M., Putnam, W. C., and Richards, G. L.
Elevated Shorelines of the Santa Monica Mountains, California.

Finch, R. H.
Lava Tree Casts and Tree Molds.

Gazin, C. Lewis.
Geology of the Central Portion of the Mount Pinos Quadrangle, Ventura and Kern counties, Southern California.

Grant, U. S., IV.
The Importance of the Genotype in Taxonomy.

Hanna, G. Dallas.
Silicoflagellates from the Lillis Shale.

Hanna, G. Dallas.
Diatoms from the Lillis Shale.

Hinds, Norman E. A.
The Most Ancient Formations in the Klamath Mountains.

Hulin, Carlton D.
Subsequent Faulting in the Great Basin.

Jenkins, Olaf P.
Stratigraphic Problems of the Kreyenhagen Shale, California.

Louderback, George D.
Geological Conditions at the Lafayette Dam.

Matthew, W. D.
Critical Observation on the Phylogeny of the Rhinoceroses.

Moore, Bernard N.
Geology of a Portion of the Santa Ana Mts., Orange County, California.

Muller, Siemon Wm.
Upper Triassic Stratigraphy of the Hawthorne and Tonopah Quadrangles, Nevada.

Nelson, Richard N., and Schenck, Hubert G.
Eocene Algae and Stellate Orbitoids from the Santa Ynez Range, California.

Nickell, F. A.
Geology of the Soledad Quadrangle, Central California.

Quayle, Ernest H.
Corals of the Genus Caryophyllia from California.

Ray, J. C.
Synthetic Sulphide Replacement of Ore Minerals.

Read, Charles B.
The Age and Affinities of the Lamar Valley.

Reed, R. D.
Petrology of the Calcareous Beds of San Pedro Hills, California.

Reed, R. D.
Concretions and Geological Research.

Rogers, Austin F.
Geological History of Lone Hill, Santa Clara County, California.

Russell, Richard Joel.
Do Fault Patterns Indicate Type of Displacement?

Schenck, Hubert G.
Miocene Brown Shale of the Kettleman Hills Wells, California.

Schenck, Hubert G.
Cephalopods of the Genus Aturia from Western North America.

Stanton, Jr., and Layton, W.
Geology of the Adelaida Quadrangle, California.

Taliafero, N. L.
Analcite Diabase and Related Rocks in California.

Vaughan, T. Wayland.
Investigations of Geological Significance at The Scripps Institution of Oceanography.

Vaughan, T. Wayland.
Notes on Larger Foraminifera.

Weaver, Charles E.
Stratigraphic Relations of the Domengine and Markley Formations in the Antioch, Vacaville, and Napa Quadrangles.

Wood, H. O., and Buwalda, J. P.
Horizontal Displacement Along the San Andreas Fault in the Carrizo Plain, California.

OIL FIELD DEVELOPMENT OPERATIONS

R. D. Bush, State Oil and Gas Supervisor

From December 29, 1929, to and including March 29, 1930, the following new wells were reported as ready to drill:

Company	Sec.	Twp.	Range	Well No.	Field
FRESNO COUNTY:					
Standard Oil Co.	29	21	17	65	Kettleman Hills
Oceanside Oil Co.	33	22	16	4	Kettleman Hills
Rio Grande Oil Co.	35	13	16	Edison 1	Kettleman Hills
Western Gulf Oil Co.	26	15	12	Lillis-Welsh 1	Kettleman Hills
KERN COUNTY:					
Continental Oil Co.	36	27	20	Result 1	Belridge
Union Oil Co.	36	27	20	Gibson 5	Belridge
General Petroleum Corp.	6	28	23	Morris 1	Buttonwillow Gas
Lincoln Drilling Co.	17	29	24	1	Buttonwillow Gas
Milham Exploration Co.	5	28	23	Kern 7	Buttonwillow Gas
Milham Exploration Co.	5	28	23	Kern 8	Buttonwillow Gas
Milham Exploration Co.	5	28	23	Kern 9	Buttonwillow Gas
Milham Exploration Co.	5	28	23	Kern 10	Buttonwillow Gas
Mohawk Petroleum Co.	27	29	27	6	Fruitvale
Shell Oil Co.	14	29	27	Shepard 1	Fruitvale
Shell Oil Co.	21	29	27	Moore 1	Fruitvale
Superior Oil Co.	28	29	27	Scheel 1	Fruitvale
C. C. M. O. Co.	23	28	27	31	Kern River
C. C. M. O. Co.	23	28	27	32	Kern River
C. C. M. O. Co.	23	28	27	33	Kern River
Welport Oil Co.	26	29	21	2	McKittrick
Welport Oil Co.	26	29	21	7	McKittrick
C. C. M. O. Co.	7	32	23	9	Midway
Honolulu Consolidated Oil Co.	8	32	24	51	Midway
Honolulu Consolidated Oil Co.	8	32	24	52	Midway
Honolulu Consolidated Oil Co.	8	32	24	62	Midway
Republic Petroleum Co.	7	32	23	37	Midway
Standard Oil Co.	1	32	23	45	Midway
Standard Oil Co.	1	32	23	76	Midway
Standard Oil Co.	1	32	23	99	Midway
Standard Oil Co.	9	32	24	45	Midway
Union Oil Co.	27	32	23	Reeves 1	Midway
C. C. M. O. Co.	26	27	28	Mon 1	Mt. Poso
A. Bruce Frame	27	26	28	Salisbury 1	Mt. Poso
A. Bruce Frame	28	26	28	Dominion 4	Mt. Poso
General Petroleum Corp.	16	27	28	Heisen 53	Mt. Poso
General Petroleum Corp.	21	27	28	Glide 21 5	Mt. Poso
General Petroleum Corp.	21	27	28	Glide 21 28	Mt. Poso
Petroleum Securities Co.	26	27	28	Gardner 2	Mt. Poso
Petroleum Securities Co.	26	27	28	Gardner 3	Mt. Poso
Shell Oil Co.	16	27	28	Security 5	Mt. Poso
Signal Oil and Gas Co.	27	27	28	Signal Glide 22-B	Mt. Poso
The Texas Co.	4	27	28	Alta Vedder 4	Mt. Poso
Union Oil Co.	4	27	28	S. & M. 8	Mt. Poso
Shell Oil Co.	20	28	29	Freeman 7	Round Mountain
Shell Oil Co.	21	28	29	Olcese 1	Round Mountain
Shell Oil Co.	29	28	29	Jewett 11	Round Mountain
Superior Oil Co.	1	28	28	Coffee 1	Round Mountain
Barnsdall Oil Co.	17	11	23	Hazelton 3	Sunset
California Western Oil Co.	17	11	23	Havenstrite 3	Sunset
California Western Oil Co.	17	11	23	Havenstrite 5	Sunset
Doyle Clune Oil Co.	8	11	23	Doyle Clune 1	Sunset
Doyle Petroleum Corp.	8	11	23	Son-Crail 7	Sunset
Doyle Petroleum Corp.	8	11	23	Son-Crail 8	Sunset
The Hancock Oil Co.	8	11	23	Maricopa 5	Sunset
Lake View Oil and Refining Co.	4	11	23	Midway Fields 16	Sunset
Reservoir Hill Gasoline Co.	17	11	23	Havenstrite 5	Sunset
Universal Exploration Co., Ltd.	7	11	23	1-B	Sunset
Wellington Oil Co., Ltd.	8	11	23	Wellington-Maricopa 2	Sunset
Wellington Oil Co., Ltd.	8	11	23	Wellington-Maricopa 3	Sunset
H. A. Bardeen	10	10	23	Ramsey 1	----------
H. A. Bardeen	18	10	23	Klipstein 1	----------
Nick Gerard Oil Co.	28	26	18	Watkins 1	----------

OIL FIELD DEVELOPMENT OPERATIONS—Continued

Company	Sec.	Twp.	Range	Well No.	Field
KERN COUNTY—Continued					
Helen Petroleum Corp., Ltd.	23	25	27	1	
Moran and De Camp	26	10	14	Marsh 1	
Fred M. Sayre	5	20	29	O. S. E. 1	
Shell Oil Co.	36	28	26	K. C. L. 2	
Shell Oil Co.	33	29	29	Edison 1	
Shell Oil Co.	29	30	29	Porter-Day 1	
LOS ANGELES COUNTY:					
Graham-Loftus Oil Corp.	18	3	9	1	Coyote Hills
Standard Oil Co.	13	3	11	Emery 46	Coyote Hills
Shell Oil Co.	34	3	13	Manuel 7	Dominguez
L. C. Simmel	21	2	14	1	Inglewood
Standard Oil Co.	17	2	14	L. A. Inv. 1 62	Inglewood
J. Oscar Smith	17	3	14	Johnson 3	Lawndale
Apache Oil Co.	29	4	12	Apache 1	Long Beach
Bryan and Stone, Inc.	29	4	12	Burke 1	Long Beach
Robert Burns	13	4	13	1	Long Beach
Colonial Oil Corp.	33	4	12	Gentry 1	Long Beach
Commercial Oil Corp., Ltd.	24	4	13	1	Long Beach
Dabney-Johnston Oil Corp.	33	4	12	54	Long Beach
Dabney-Johnston Oil Corp.	24	4	13	50	Long Beach
Devonshire Oil Co.	29	4	12	1	Long Beach
D. D. Dunlap	30	4	12	3	Long Beach
Exeter Oil Co.	29	4	12	Coleman 1	Long Beach
General Petroleum Corp.	19	4	12	Kelly 4	Long Beach
J. L. Keck	29	4	12	5	Long Beach
A. H. MacFarland	13	4	13	2	Long Beach
J. S. McCluskey	29	4	12	Cook 1	Long Beach
The McKeon Oil Co.	29	4	12	7	Long Beach
Ben F. Mun	29	4	12	Fee 1	Long Beach
Petroleum Properties, Inc.	33	4	12	1	Long Beach
Petroleum Securities Co.	29	4	12	Painted Hills 1	Long Beach
Petroleum Securities Co.	29	4	12	Wilson 1	Long Beach
Petroleum Securities Co.	13	4	13	Bixby 2	Long Beach
Shell Oil Co.	29	4	12	Patton Wilson 10	Long Beach
Shell Oil Co.	29	4	12	Patton Wilson 11	Long Beach
The State Co.	29	4	12	Pike 1	Long Beach
The Texas Co.	29	4	12	Chamberlin 2	Long Beach
Young Petroleum Corp.	29	4	12	Hilton 1-A	Long Beach
H. C. Hicks	8	3	15	Lillie 1	Newhall
Pioneer Petroleum Co., Ltd.	14	3	16	1	Newhall
Seigenberg, Horton and Rogers	1	3	16	Warren 1	Newhall
York-Smullin Oil Co.	13	3	16	2	Newhall
E. A. Featherstone	21	2	15	1	Playa del Rey
The Ohio Oil Co.	21	2	15	Edgar K. Brown 1	Playa del Rey
The Ohio Oil Co.	21	2	15	G. and W. G. Dickinson 1	Playa del Rey
The Ohio Oil Co.	21	2	15	G. and W. G. Dickinson 2	Playa del Rey
The Ohio Oil Co.	21	2	15	G. D. Howland 1	Playa del Rey
The Ohio Oil Co.	21	2	15	Recreation Gun Club 2	Playa del Rey
The Ohio Oil Co.	22	2	15	Del Rey Land & Water Co. 2	Playa del Rey
Union Oil Co.	28	2	15	Del Rey 1	Playa del Rey
Tom Johnson	28	2	14	1	Potrero
Bell View Oil Syndicate	6	3	11	Santa Fe 5	Santa Fe Springs
George F. Getty, Inc.	6	3	11	S. F. S. 49	Santa Fe Springs
Continental Oil Co.	3	5	12	Bixby 33	Seal Beach
George F. Getty, Inc.	27	2	12	Kellam 1	
The Ohio Oil Co.	35	3	14	R. H. Fish 1	
Packard Oil Corp., Ltd.	17	4	13	1	
Shell Oil Co.	19	2	15	Andrews 1	
Tureco Oil Co., Ltd.	29	2	11	Cole 1	
MADERA COUNTY:					
George F. Getty, Inc.	8	10	14	Chowchilla 1	

OIL FIELD DEVELOPMENT OPERATIONS—Continued

Company	Sec.	Twp.	Range	Well No.	Field
ORANGE COUNTY:					
W. H. Carlson	11	6	11	Carlson-Ford 1	Huntington Beach
Richfield Oil Co.	2	6	11	Heaston 1	Huntington Beach
West American Oil Co.	35	5	11	Kiesau 2	Huntington Beach
H. L. Hall et al.	20	6	10	1	Newport
Continental Oil Co.	33	3	9	Stern 2	Richfield
Continental Oil Co.	33	3	9	Winann 4	Richfield
SAN BERNARDINO COUNTY:					
Keck and Hall	32	2	8	Belyea 1	
SANTA BARBARA COUNTY:					
Bankline Oil Co.	15	4	29	89–3	Elwood
Barnsdall Oil Co.		4	29	Doty 6	Elwood
Barnsdall Oil Co.	15	4	29	Luton-Bell 12	Elwood
Barnsdall Oil Co.	15	4	29	Luton-Bell 17	Elwood
Bolsa Chica Oil Corp.	23	4	29	Taylor 1	Elwood
Bolsa Chica Oil Corp.	24	4	29	Security 1	Elwood
Bolsa Chica Oil Corp.	25	4	29	Augur 1-A	Elwood
Brown Caldwell Syndicate	24	4	29	Vivian 1	Elwood
Pacific Western Oil Co.	15	4	29	Goleta 2	Elwood
Pacific Western Oil Co.	16	4	29	92–3	Elwood
Pacific Western Oil Co.	16	4	29	92–4	Elwood
Seaward Oil Co., Ltd.	22	4	29	Mahoney 2	Elwood
Caroline C. Spalding	16	4	29	Blue Goose 3	Elwood
O. C. Field Gasoline Corp.	8	9	33	1	Santa Maria
George F. Getty	21	4	26	State Lease No. 16, Getty 21	Summerland
Altadena Oil Co.	20	4	28	1	
Wesley Cunningham	4	4	30	177–1	
R. S. Durkee	4	4	30	176–1	
El Camino Oil Co., Ltd.	22	4	28	Permit 149 1	
Exeter Oil Co.	32	4	25	1	
Henry Berrien Fish	32	4	25	Fish 164 1	
General Petroleum Corp.	32	5	30	Erburu 2	
D. A. Hargrave	27	4	27	Law 2	
McDonald Drilling Co.	32	4	25	165–1	
W. L. McLaine	4	4	30	175–1	
Oakburn Drilling Co.	4	4	30	1	
E. R. Rich	4	4	30	178–1	
Shell Oil Co.	5	4	30	Covarrubias 2	
Shell Oil Co.	1	4	31	Rutherford 3	
Justin S. Snow	32	4	25	1	
W. H. Taylor		7	35	Packard 1	
Universal Consolidated Oil Co.		5	35	Concepcion 1	
TEHAMA COUNTY:					
Orland Oil Syndicate, Ltd.	31	23	3	1	
TULARE COUNTY:					
Ducor Petroleum Co.	14	24	27	1	
VENTURA COUNTY:					
General Petroleum Corp.	6	3	19	John B. 1	Bardsdale
C. C. M. O. Co.	17	3	24	Hobson C. 6	Rincon
Universal Exploration Co.	21	4	21	Anlauf 2	Santa Paula
Wheeler Canyon Oil Co.	24	4	22	18	Santa Paula
Associated Oil Co.	22	3	23	Hartman 15	Ventura
Associated Oil Co.	23	3	23	V. L. & W. 9-A	Ventura
Associated Oil Co.	27	3	23	Lloyd 57	Ventura
G. C. Noble	9	3	23	1	Ventura
Shell Oil Co.	28	3	23	Taylor 50	Ventura
Shell Oil Co.	29	3	23	Taylor 55	Ventura
Shell Oil Co.	29	3	23	Taylor 56	Ventura
Shell Oil Co.	29	3	23	Taylor 59	Ventura
Shell Oil Co.	29	3	23	Taylor 60	Ventura
Calleguas Oil Syndicate	6	1	20	1	
Shell Oil Co.	14	2	20	Everett 2	
Shell Oil Co.	23	2	20	Everett 1	
Shell Oil Co.	14	2	22	Cohn 2 1	
Shell Oil Co.	27	2	22	McGrath 2-B	
Shell Oil Co.	35	2	22	Thatcher 1	

SPECIAL ARTICLES

Detailed technical reports on special subjects, the result of research work or extended field investigations, will continue to be issued as separate bulletins by the Bureau, as has been the custom in the past.

Shorter and less elaborate technical papers and articles by members of the staff and others are published in each number of 'Mining in California.'

These special articles cover a wide range of subjects both of historical and current interest; descriptions of new processes, or metallurgical and industrial plants, new mineral occurrences, and interesting geological formations, as well as articles intended to supply practical and timely information on the problems of the prospector and miner, such as the text of the new laws and official regulations and notices affecting the mineral industry.

MINERAL PAINT MATERIALS IN CALIFORNIA

By Henry H. Symons

There has been a steady production of mineral paint in California since 1890, when the first recorded production was made. The materials have come from Alameda, Amador, Butte, Calaveras, Colusa, Los Angeles, Napa, Nevada, Placer, Riverside, Shasta, Sonoma, Stanislaus, and Ventura counties, with a total of 22,897 tons valued at $219,098 to the end of 1929. There are also other deposits that may have a possible commercial value, but as yet there have been no commercial shipments from El Dorado, Imperial, Kern, Kings, Lake, Mendocino, San Diego, Siskiyou, Trinity, and Yuba counties, in which they have been noted.

Year	Tons	Value	Year	Tons	Value
1890	40	$480	1910	200	$2,040
1891	22	880	1911	186	1,184
1892	25	750	1912	300	1,800
1893	590	26,795	1913	303	1,780
1894	610	14,140	1914	132	847
1895	750	8,425	1915	311	1,756
1896	395	5,540	1916	643	3,960
1897	578	8,165	1917	520	2,700
1898	653	9,698	1918	728	4,738
1899	1,704	20,294	1919	1,780	17,055
1900	529	3,993	1920	779	8,477
1901	325	875	1921	446	4,748
1902	589	1,533	1922	1,620	13,277
1903	2,370	3,720	1923	1,049	11,773
1904	270	1,985	1924	532	5,234
1905	754	4,025	1925	669	6,969
1906	250	1,720	1926	569	5,846
1907	250	1,720	1927*	919	9,592
1908	335	2,250	1928*		
1909	305	2,325	1929	467	2,820
			Totals	22,897	$219,098

* Under 'Unapportioned'

Californian mineral paints have been used as: the color pigments in mortar, stucco and cement mixes, in kalsomine, pigments in oil paint, various fillers, in linoleum, in cosmetics, etc. Their colors vary greatly, as also their composition; yellow the most common is colored by limonite, red is colored with hematite, the browns might be colored

with either or both hematite or limonite, all of which are mixed with more or less clay. There are several plants in the state that treat their ochers, and blend them to give uniform colors and quality at all times. The color of the materials as they come from the mine will vary, but when properly handled a uniform quality and color can be maintained.

These deposits are found either as soft fine-grained red shales, as gossan after sulphide orebodies, as yellow or brown clays colored by water carrying iron in solution and depositing it on clay or from spring waters high in iron which deposit an iron oxide or hydroxide.

Besides the natural deposits, tailings from chlorination plants, pyrite sinter from acid works and magnetite concentrated from black sands have been used in the manufacture of synthetic ochers. Some graphite from Californian sources has also been utilized for paint purposes.

DEFINITIONS, USES, SPECIFICATIONS

The following data under the above heading are extracted from a recent publication of the United States Bureau of Mines.[1]

General Description.

"Ocher or ochery earth is a natural mineral pigment composed largely of clay permeated with hydrated iron (ferric oxide).[2] Its color ranges from yellow through to reddish brown, depending, largely on the amount of iron present. Ocher grades into sienna, which differs from ocher chemically in that it generally contains more ferric iron than it does clay, and physically in that when finely ground it is more of a stain than a pigment. Good grades of ocher should contain 20 or more per cent iron oxide, but the iron content and hence of the material marketed varies widely. Ocher has a specific gravity of about 3.5.

Color Variations.

"*Cream ocher* contains as low as 5 per cent iron hydroxide. It is used to some extent as a primer on wood, but has little value as a pigment.

"*Gray ocher* is silica, clay, and carbonaceous matter. Sometimes it is colored slightly green by a trace of ferrous hydroxide. It is used as a filler for cheap paint.

"*White ocher* is nothing but ordinary clay, and has no value in paint, although it is occasionally used as an adulterant.

"*Golden ocher* is ocher which has been toned up with some chrome yellow. Various shades of it are on the market. Perfect orange-colored shades contain as much as 12 to 15 per cent chrome yellow. The base may be either French or domestic ocher.

"*Green ocher* is similar in composition to gray ocher, except that it contains a larger proportion of ferrous hydroxide. It is found principally in Bohemia (Czechoslovakia), and goes by the name of "terre verte." It has no hiding power when used alone in paints, but as it has a high absorbent capacity for certain aniline colors, it is largely used as a base for cheap lakes. Verona green, Veronese earth, green earth, etc., are similar products.

"*Red ocher* is obtained by calcining raw ocher at a low heat so as to drive off a part of the combined water. The shade depends upon the time of heating and the iron content—the longer the calcination the more purple the product. Burnt ochers are sold as Indian red, Venetian red, light red, etc. As a rule, however, these ochers are much richer in iron than ordinary ocher, which almost never contains more than 30 per cent iron oxide.

Uses and Specifications.

"There are two principal uses for ocher—in paints and as a filler for linoleum and oil cloth. Ocher is also used to a limited extent as a pigment in coloring cement stuccos and mortars, for producing desired colors in earthenware when mixed with manganese oxide, and in very limited quantities for other minor uses. It does not seem to follow that the best ocher for color pigments in paints is necessarily the most desirable as a filler in linoleum.

"Domestic ochers of the best quality make excellent pigments, work well with all vehicles and with other pigments, and are permanent in color. When mixed with white, fine cream or buff tints are obtained. Chrome yellow is sometimes added to ocher of inferior color to impart a brighter tint than the natural color, but the chrome yellow fades after a time and leaves only the natural ocher effect.

"Color would seem to be less important in ocher for use in lineoleum and oil cloth, and this perhaps accounts for the fact that a large quantity of domestic ocher has been exported for use as a filler, giving as good service as the better colored but more expensive French ocher.

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[1] Santmyers, R. M., Ocher and Ochery Earths: U. S. Bureau of Mines, Circular No. 6132, pp. 2-5, 8, 14, May, 1929.

[2] United States Tariff Commission, Tariff Information Survey, Par. 55, Act of 1913, A-15.

"Georgia ocher has been used chiefly as a filler in the manufacture of linoleum and oil cloth, and much of it has been exported to England and Scotland for that purpose. Some of it is used for the same purpose in this country. It is also employed in the manufacture of paints, and in a variety of minor ways. This ocher when calcined yields a red pigment which is becoming of importance, especially as a mortar color, and is finding its way into the markets in growing quantities.

"Pennsylvania ocher has been used principally in the manufacture of paints.

"The United States Army states in its paint specifications that yellow ocher must be equal in color and quality to the best French ocher, must be free from chromate of lead or any foreign coloring matter, and must contain at least 20 per cent oxide of iron and not more than 5 per cent lime.

"Other specifications prepared and recommended by the United States Interdepartmental Committee on Paint Specification Standardization, published in Circular 91 of the Bureau of Standards, states that the dry pigment shall be a hydrated oxide of iron permeating a siliceous base, and shall be free from added impurities. It must all pass a 200-mesh screen, contain no less than 17 per cent iron oxide, not more than 5 per cent lime, no lead chromate or organic colors, and must equal the sample mutually agreed on by buyer and seller in color, color strength, and tone.

"Ocher in paste form shall contain not more than 71 or less than 69 per cent pigment, not more than 31 or less than 29 per cent linseed oil, not more than 0.5 per cent moisture, or more than 0.5 per cent coarse particles and skins (total residue on No. 200 screen).

Substitutes.

"Ocher has no substitutes in the sense of similar cheaper products, since it is the cheapest of the common yellow pigments and competes, especially in the golden grades, with more expensive products like chrome and zinc yellows. Artificial ochers, of composition somewhat similar to that of natural ocher, and yellow clay mixed with more or less ocher, are used to a limited extent in the cheaper grades of linoleum. Powdered slate and ground shale are now actually preferred by certain linoleum and oil cloth manufacturers who in past years were heavy consumers of ocher.

Artificial Ocher.

"Since ocher consists essentially of hydrated oxide of iron, similar material can be prepared by precipitating iron salts. Artificial ochers have been made from copperas ($FeSO_4.7H_2O$) by pouring a solution of this salt into milk of lime and thereby forming a precipitate of calcium sulphate and iron (ferrous) hydroxide. This material is shoveled onto boards, allowed slowly to oxidize, and dried promptly when the proper shade of color is reached. An artificial ocher prepared in this way is likely to contain an excess of lime, which is detrimental for many purposes. Artificial ocher suitable for calcining to form red ochers and various iron paints is prepared by chemical precipitation, often using very pure materials. Alum sludge and various metallurgical by-products containing iron salts are likewise worked up into ocher.

Mining.

"As a general rule, ocher is a decomposed product or iron-bearing mineral which has been transported by water (often in admixture with clay) and finally deposited in seams, pockets, or what at one time were shallow pools. Occasionally, as in Georgia, it is found just above bedrock and beneath a residual capping—sometimes even it extends downward into cracks and fissures of the bedrock; more often, however, it forms irregular masses or lenses in residual or transported clays.

"Most of the ocher deposits in the United States can not be mined systematically because of their irregular and pockety nature. Wherever possible, the overburden is stripped off, but when it is too thick, either tunnels are driven into the hillside or shafts are sunk, depending upon the topography. Shorter drifts or tunnels are driven from the main openings at suitable points, and the ocher is mined wherever it is found. A number of levels, one above the other, have been opened at several localities.

"Even when the deposits are quite dry, timber ordinarily has to be used in the main drifts. Moreover, if either the ocher or the overburden is at all wet, timbering must be kept close to the face, and it will be necessary to mine out a given block of ground as rapidly as possible before too much weight comes on the timbers or before the wet clay or ocher oozes excessively into the workings. In Pennsylvania, where the deposits are erratic and pockets of ore are relatively small, operations are at present all open-cut, although shafts are at times employed wherever the beds lie more than 10 to 15 feet below the surface. The ocher, since it is more or less mixed with clay, must be removed very carefully; otherwise, since the clay can not be removed by washing and settling, the product becomes too low-grade.

* * * * * * *

Beneficiation.

"The preparation of ocher for market is ordinarily quite simple, involving merely a rough separation of the ocher from impurities that may be mixed with it. The sequence of processes is essentially similar in all districts and includes washing, drying, pulverizing, and packing. The purpose of washing is primarily to rid the product of sand, small stones, and other foregn matter which may be associated with the ocher in nature or which has been mixed with it in mining. The washing process, since it thoroughly mixes the ocher, enables a more uniform product to be prepared. Sometimes it is also possible to improve the color or to produce minor modifications in the shade.

"In Georgia, due to the fact that several of the deposits are large enough to justify the requisite expense, the plants are permanent and relatively more elaborate than in Pennsylvania, for example, where the deposits are small.

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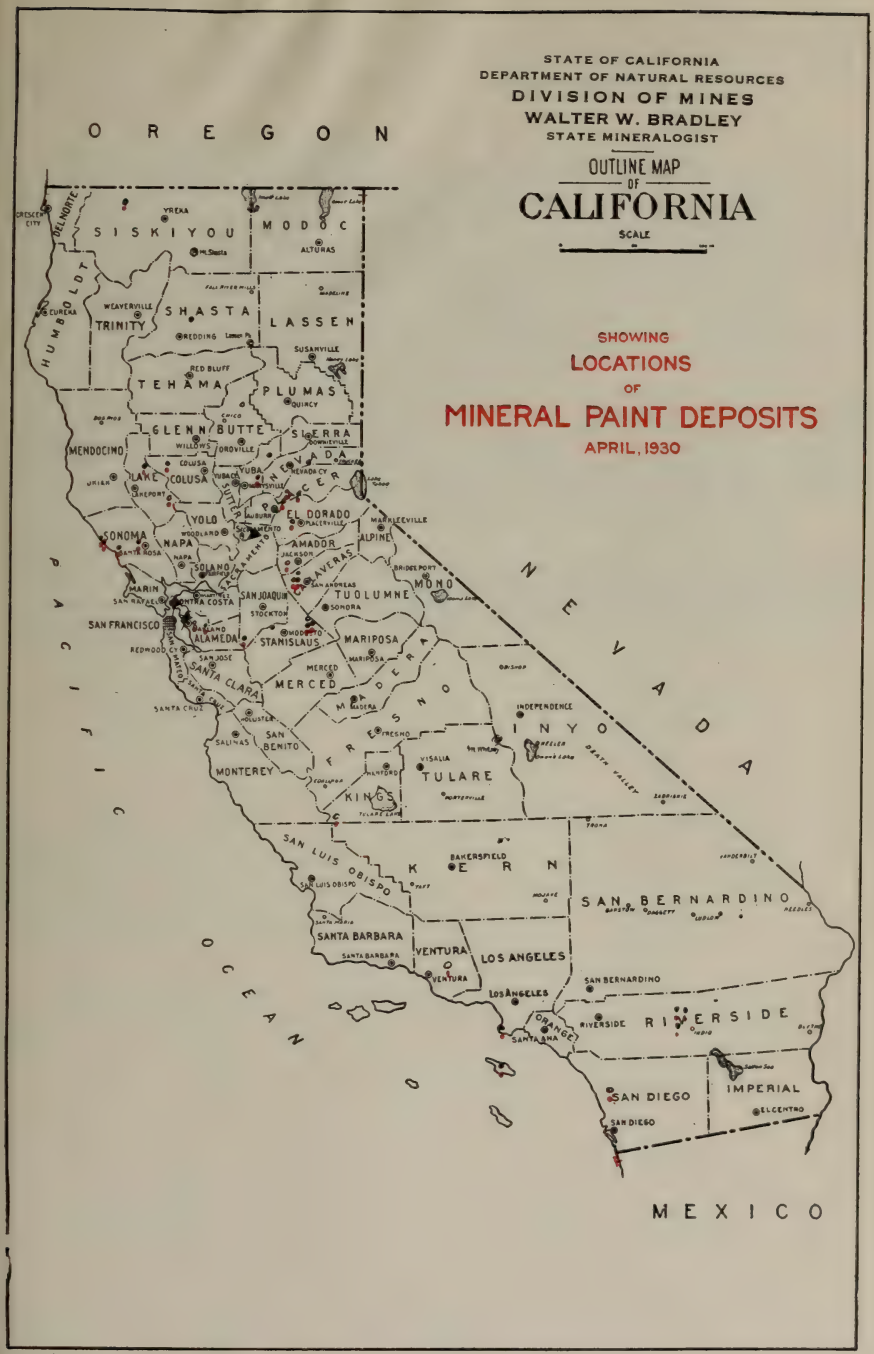
STATE OF CALIFORNIA
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF MINES
WALTER W. BRADLEY
STATE MINERALOGIST
OUTLINE MAP
OF
CALIFORNIA
SCALE
SHOWING
LOCATIONS
OF
MINERAL PAINT DEPOSITS
APRIL, 1930
OREGON
NEVADA
PACIFIC OCEAN
MEXICO
SISKIYOU
MODOC
SHASTA
LASSEN
TRINITY
HUMBOLDT
TEHAMA
PLUMAS
GLENN
BUTTE
SIERRA
NEVADA
PLACER
MENDOCINO
LAKE
COLUSA
YUBA
YOLO
EL DORADO
SONOMA
NAPA
AMADOR
SOLANO
ALPINE
MARIN
CONTRA COSTA
SAN JOAQUIN
TUOLUMNE
MONO
SAN FRANCISCO
ALAMEDA
STANISLAUS
MARIPOSA
SANTA CLARA
MERCED
MADERA
FRESNO
INYO
SAN BENITO
MONTEREY
TULARE
KINGS
SAN LUIS OBISPO
KERN
SAN BERNARDINO
SANTA BARBARA
VENTURA
LOS ANGELES
RIVERSIDE
ORANGE
SAN DIEGO
IMPERIAL

77004

Domestic Deposits.

"Ocher is produced more or less regularly in the following states named in order of importance: Georgia, Pennsylvania, Virginia, Alabama, California, Iowa and Vermont. Deposits have been found in other states, but are not known to have maintained any important production. In the Pacific northwest, however, certain deposits, notably in western Washington, are of considerable potential importance commercially.

* * * * * * *

Status of the Domestic Industry.

"The ocher industry in the United States comprises mostly small intermittent operations, although some permanence is in evidence in the Georgia field. Owing partly to the pockety nature of the occurrence and partly to the difficulty and uncertainty of finding a continuous market, domestic ocher suffers severely in competition with the well-established French products which are considerably superior to the domestic product. Imported ochers, as a class, have a better permanent color than those produced in this country, but their leading advantages are the result of more uniform deliveries and standardized grading. In the linoleum and oilcloth industries, into which the domestic product enters in large quantity, exact shades of color are of less significance than other properties.

"No actual production figures have been published since 1914. In that year 14,387 tons were produced, having a value of $136,185, which were divided as follows: Georgia, 8607 tons, valued at $84,193; Pennsylvania, 3799 tons, valued at $34,223; and other states 1981 tons, valued at $17,769.

"In the reports of the Bureau of the Census, the production of ocher is included with that of other iron oxides, both natural (sienna, umber, etc.), and synthetic (precipitated). For this larger group the output was reported as 54,180 tons valued at $3,357,895 in 1927, a large increase as compared with 33,895 tons, valued at $2,151,445, reported for 1925. For ocher alone, unofficial estimates place production at approximately 22,000 tons, proportioned as follows: Georgia, 15,000 tons; Pennsylvania, 5000 tons; and all other states, 2000 tons. There is no doubt, however, that some yellow clay is included in these estimates, especially in Pennsylvania.

Imports and Exports.

"The imports of ochers and siennas into the United States in recent years have shown a gradual increase. * * * The tonnage from France, which furnishes the bulk of the imports into the United States, has shown practically no increase, but the value of the ocher imported from that country has more than doubled during the past four years."

CALIFORNIAN OCCURRENCES

ALAMEDA COUNTY

Leona Heights. About four miles southeast of the Oakland City Hall there is a deposit of pyrite in a rhyolite belt; near the surface the pyrite has been altered to limonite and hematite. *C. K. Williams & Co. of California* shipped some of this material from *Alma Mine* to their plant at Shellmound Park, Emeryville, for experimental purposes last year.

Bibl: State Mineralogist's Reports XVII, pp. 32–33; XXV, pp. 439–441. Bull. 50, pp. 169–170; 38, p. 349. U. S. Geol. Survey, Folio 193.

McLean Red Shale Deposit. A red cherty shale, outcrops in several places on the old John Berendiere property, 12 miles southeast of Livermore in Sec. 14, T. 4 S., R. 3 E. The rock is a dark colored, highly stratified, fairly uniform in quality and color with a greasy schistose appearance on some of the cleavage faces, being similar to rock mineral in Pennsylvania used in the manufacture of linoleum. This material has been tested at various times for the making of paints, but has never been used for that purpose. W. S. McLean, 1919 San Bruno Ave., San Francisco, has a lease on 160 acres and has been operating a quarry for the past eight years. The shale is hauled by truck to Livermore and then shipped by rail to McLean's mill in San Francisco, where it is used in making red roofing granules. At present about 10 cars per month are being shipped.

Bibl: State Mineralogist's Reports XVII, p. 28; XXV, p. 437.

AMADOR COUNTY

At many places overlying sands and clay of the Ione formation, red and yellow iron oxide occur. Most of this material is red oxide, mixed with more or less clay or sand. Very few places were noted where the material was in quantity sufficient to be of commercial interest or of high quality. It is in the form of concentrations on the surface or mixed with the soil.

Some of the piles of chlorination tailings resulting from the treatment of gold-bearing sulphides at mines along the Mother Lode years ago would be suitable for paint.

Bibl: State Mineralogist's Report XXIII, p. 201.

BUTTE COUNTY

Chico Ocher and Mineral Paint Company's Deposit. An ocher deposit occurs on 360 acres of land in Secs. 5 and 6, T. 23 N., R. 4 E., near the Doon road and a mile from the Southern Pacific Railroad.

There was some production prior to 1900. The deposit was worked through an adit 200 feet long and a small open pit.

CALAVERAS COUNTY

On the *Holmes* ranch, at Campo Seco there is a body of decomposed slate, stained by iron oxide, which has proved to produce a durable paint.

Bibl: State Mineralogist's Reports XIV, p. 130; XXI, p. 168.

Late Ocher Mine, one-half mile west of Valley Springs, produced several carloads of ocher 30 to 35 years ago, but has been idle lately. The ocher varies in color from a yellow to a dark red.

Bibl: Cal. State Min. Bur. Bull. 38, p. 338; State Mineralogist's Report XXI, p. 168.

D. F. Rhoden of Valley Springs reports to the Division an ocher deposit three miles from that place. Samples of brown and yellow ocher were submitted, but the deposit has not been visited so that the extent and character are not yet of record.

Bibl: State Mineralogist's Report XXI, p. 168.

There are several deposits of iron ore in Calaveras County, some of which might be suitable for paint. The ore is mostly limonite.

COLUSA COUNTY

Ruby King Mineral Paint Mine is in Secs. 29 and 31, T. 17 N., R. 6 W., four miles south of west of Lodoga and 27 miles by road from Arbuckle, the nearest railroad point. The 40 acres of patented ground on which the mill and principal workings were, have been sold to the state for unpaid taxes and nearly all movable equipment has been removed. The unpatented mining claims have reverted to the public domain. No work has been done for several years. What little paint material there is left in sight appears quite siliceous. It occurs irregularly in lumps and small masses.

Bibl: Cal. State Min. Bur. Bull. 50, p. 160; State Mineralogist's Report XIV, pp. 180–181, p. 46; U. S. Geol. Survey, Mineral Resources, 1910, Pt. 1, p. 697; 1911, Pt. 1, p. 901; 1912, Pt. 1, p. 939.

EL DORADO COUNTY

Samples of both red and yellow ocher have been brought to the attention of the State Division of Mines from several parts of the county. The deposits have not been visited as most of them are remote from railroad.

Bibl: State Mineralogist's Report XXII, p. 444.

IMPERIAL COUNTY

Mullet Island Paint Deposit. A number of thermal springs occur on the north end of Mullet Island at the south east end of the Salton Sea. These springs deposit iron oxide about their vents in the form of yellow and red ocher. Owner, Capt. Chas. Davis, Niland.

Bibl: State Mineralogist's Report XXII, p. 277.

KINGS COUNTY

An occurrence of mineral paint is associated with a gypsum deposit in Section 13, T. 24 S., R. 17 E., northwest of Dudley.

Bibl: State Mineralogist's Report XIV, pp. 526–527.

LAKE COUNTY

Bartels Bros. Deposit. In Sec. 3, T. 15 N., R. 7 W., 2 miles north of Hough Springs. The deposit forms a low spur off one of the higher mountain ridges, and is said to be exposed for a width of 100 feet and 1500 feet in length. There are two colors lying alongside of each other, one being between a burnt umber and burnt sienna in

shade, and the other a slightly dark, yellow ocher. The material is pulverulent, requiring little or no grinding, only screening and bolting, to prepare it for use as paint. Pits have been dug in the deposit to a depth of 10 feet, still showing the same character of material as appears at the surface. Samples have been shipped for tests and small amounts have been used for painting around Hough Springs, which is on the main stage road 26 miles west from the railroad at Williams.

There is a deposit of hematite in Jerusalem Valley, near Dollar Springs, in Sec. 8, T. 11 N., R. 5 W., northwest from Middletown. It has been used locally for paint.

Bibl: State Mineralogist's Report XIV, p. 207.

LOS ANGELES COUNTY

Santa Catalina Island. The occurrence of red and yellow ocher was noted along the oxidized croppings on the lead-silver-zinc veins in Renton Canyon. Above No. 4 tunnel on the Renton Vein near the automobile road to No. 3 tunnel, there is exposed a vein of red ocher that is 6 to 18 inches wide. Tests of this material have been made for its use in paint.

Bibl: State Mineralogist's Report XXIII, p. 38, 329.

Two or three miles north of Redondo, on the coast, there are some bluffs of very fine, pure clays, of yellow, brown and ocher tints, very suitable for mineral paints, for which they have been tested by practical painters.

Bibl: State Mineralogist's Report IX, p. 208; report XV, p. 507; Bull. 38, p. 388.

Graphite. Deposits of crystalline graphite occur in Los Angeles County in Kagel Canyon east of San Fernando, in San Francisquito Canyon northeast of Saugus, and in the Verdugo Hills northwest of Montrose. The graphite occurs in fine crystalline flakes disseminated through a schist, and requires concentration. All of these deposits have been worked commercially at various times, and the product shipped for use as a paint pigment, as well as for foundry facing and boiler compound.

Bibl: State Mineralogist's Reports XV, pp. 501–504; XVII, pp. 318–319; XXIII, pp. 325–327.

MENDOCINO COUNTY

There is a red rock thought to be suitable for paint making on the property of Mrs. *Effie M. Heughes* of Calpella. It is on patented land in Sec. 27, T. 17 N., R. 12 W., formerly a part of the Yorcho Ranch. The total area is 360 acres, but undeveloped. There is also manganese reported on the property. A good road runs to the property, which is 14 miles northwest of Ukiah.

Bibl: State Mineralogist's Report XVII, p. 146.

NAPA COUNTY

The *Carl Browne Paint Mine,* on Benali Mountain, 2 miles south of Calistoga. It is now owned by W. R. Teale. Some shipments of white clay have been made to Richmond, where it was used in making

porcelain ware and some was shipped to Oakland for the manufacture of bisque doll heads several years ago, but none has been mined during the past year. There are other exposures of this material in the immediate neighborhood. On this property red iron oxide and koalin also occur.

No work was done during the past year at the property of the *California Paint Mineral and Mining Company*, owned by Mrs. Ellen M. Knoles. Shipments of yellow ocher were made several years ago.

Bibl: State Mineralogist's Reports XIV, p. 276; XVII, p. 159. Bull. 38, p. 339.

NEVADA COUNTY

Previous to 1900 there were shipments of paint material of a reddish-brown oxide of iron, formed from the residue of pyrite ores mined for their copper values.

Bibl: Bull. 23, p. 165; Cal. State Min. Bur. Bull. 38, p. 339.

Paine Claims are 2.4 miles from Washington and cover the bedrock of the Alpha hydraulic diggings, long idle. Emigrant Gap, 12½ miles distant, is the nearest railroad point. R. A. Paine et al., locators, Nevada City. They are in Sec. 18, T. 17 N., R. 11 E., M. D. M.

On the Neva May and Genevieve claims both red and yellow ocher occur. The red material underlies the yellow in many spots over an area 30 feet by 100 feet. No conclusive tests of the quality have been made and no work has been done to determine the amount available.

Steele property is in E. ½ of Sec. 11, T. 15 N., R. 9 E., containing 80 acres, six miles from Colfax on the You Bet road. Mrs. M. M. Steele, owner, P. O. Box 326, Colfax.

Only a small part of the property, not over 10 acres, is covered by the material which has been tested for paint purposes. The product is of various shades, some of it earthy and friable and resembling sienna and umber in color, and elsewhere a schist or slaty rock impregnated with yellow iron oxide. Tests made at the Northwest Experiment Station of the U. S. Bureau of Mines showed that one of the samples submitted has fair value as a red sienna.

There is no equipment and the work is in the nature of shallow cuts and shafts. There is one good building, which was put up by a company who began work several years ago on the deposit.

PLACER COUNTY

Low-grade iron oxide in the form of red and yellow ocher has been shipped from the *Bancroft Ranch* and other properties in the vicinity of the *Hotaling Iron Mine*, in the Clipper Gap district. There has been no production for the past two years. This oxide is used for paint.

Some low-grade yellow ocher or iron-stained shale has been shipped from the *Everhart Brothers* property, two miles from Gold Run. While the exact use to which it was put is not known, it is believed to have been used for filler, mortar color or some similar purpose. There has been no production for the last three or four years.

Some dark reddish-brown ocher, evidently decomposed iron oxide sand, was shipped in 1924 from the vicinity of *Sugar Pine* mill nearly

25 miles by road from Colfax via Forest Hill. It was reported to have been used in paint.

Bibl: State Mineralogist's Report XXIII, pp. 283, 284; Report XV, p. 392.

J. L. Williams Sienna Mine. This property is located about 22 miles from Auburn near Forest Hill on N. E. $\frac{1}{4}$ of Sec. 30, T. 15 N., R. 11 E. and consists of 160 acres of unpatented land. J. L. Williams of Auburn, owner. The ocher is of a sienna type. The material is in a blanket formation which lies from 25 ft. to 35 ft. below the surface and was prospected by 200 test holes. The operation is carried on through 2 shafts and two 9 ft. by 16 ft. tunnels having a total length of 175 ft. This material overlies chromite. The property is operating and shipments of both chromite and ocher will be made this year. This property has not been visited by a representative of the Division as yet.

RIVERSIDE COUNTY

George W. Lord, Corona. In Sec. 14, T. 4 S., R. 7 W., about 500 yards southeast of the Paint Mine, is a ledge of yellow ocher, stated to be 8 feet wide, in a deposit of fire clay. The ocher is light-colored, fine-grained, but contains minute inclusions.

Paint Mine: Corona Pressed Brick and Terra Cotta Company, owners; formerly owned by George W. Lord. In Secs. 10, 11, 14, and 15, T. 4 S., R. 7 W., S. B. M.

National Paint and Color Company. At one time manufactured about twenty various colors—ocher, red, vermillion, gray, etc. The works are equipped with all required machinery, a 15-h.p. engine and a 35-h.p. boiler, using oil as fuel. The company owns extensive clay deposits near Corona, among which is a tract of about 20 acres containing about 5 feet of ocher, stated to be of choice quality.

Bibl: State Mineralogist's Report XV, pp. 520, 579; Bull. 38, p. 339.

SAN DIEGO COUNTY

A bedded deposit of mineral paint occurs eight miles northeast of Encinitas in Secs. 3 and 10, T. 13 S., R. 3 W., S. B. M. The deposit is traceable for a distance of some 4000 feet, its strike being nearly east, and its dip 45° N. It varies from 70 to 100 feet in width, and is underlain by diorite which forms the footwall, while the hanging-wall is basalt. Near the footwall its color is reddish and yellowish, while towards the hanging-wall it grows lighter in shade, passing from light yellow and gray to white. About 12 feet of this width is said to be of commercial value.

Bibl: State Mineralogist's Reports, XIV, pp. 668, 689–691; XXI, p. 374.

SAN JOAQUIN COUNTY

Earthy red hematite, as shale, occurs in Sec. 2, T. 4 S., R. 4 E., at the Ladd Manganese Mine.

Bibl: State Mineralogist's Report XXI, p. 191.

SHASTA COUNTY

Iron ore occurs in Shasta County at several places along the contact of the McCloud (Carboniferous) limestone and quartz-augite-diorite of the late Jurassic or early Cretaceous age.[1] The principal outcrops noted are a mile and a half north of Heroult, where considerable ore has been mined; on the northeast side of Hirz Mountain; and on the north and west side of Gray Rock.

The deposits show limonite on the surface, but magnetite deeper and are of the contact type. In places, pyrrhotite and chalcopyrite occur with the magnetite, and this leads to the belief that the deposits might prove to be gossan of copper orebodies.

Peterson Group (Deep Pit Group). Owner, T. H. Peterson, Heroult. There are 14 claims in Sec. 36, T. 34 N., R. 4 W., on the south side of Pit River, one-half mile south of Heroult. They cover a large iron gossan, 500 feet wide by a mile long north and south. A number of short adits have been run, and reported to show some pyrite and copper. The surface ore is of considerable value for mineral paint but none has been marketed as yet, although the owner has reported to have had various offers.

Bibl: State Mineralogist's Report XXII, pages 190, 192.

SONOMA COUNTY

Red and yellow ocher (hematite and limonite) mineral paint pigments were at one time produced in this county for several years, but none have been mined for a decade or more.

There are indications of iron ore along the second ridge back from the shore line, beginning about 6 miles east of Fort Ross and continuing northwest into Mendocino County. The most important locations are:

Hooper Ranch, J. W. Hooper, owner, 5 miles north of Nobles.

Lanchester Ranch, W. M. Richardson, Plantation House, owner; east of Fish Mill. Both yellow ocher and hematite occur. Some of it is siliceous, and suitable for paint.

Fort Ross, a large body 6 miles east of Fort Ross.

Bibl: State Mineralogist's Reports IV, p. 182; XI, p. 461; XXII, p. 335. Bull. 38, pp. 304, 365.

Healdsburg Paint Company Deposit. This property, known and operated in the past under various names, is on Porter Creek in T. 8 N., R. 10 W., 10 miles by road southwest of Healdsburg. The material is a low-grade hematite, high in silica; also, graphite noted.

Bibl: State Mineralogist's Reports XI, p. 462; XII, p. 406; XIII, p. 643; XIV, p. 333; XXII, p. 339. Bull. 38, p. 340.

Meeker Ocher Deposit. This deposit is an ocherous clay in Sec. 21, T. 7 N., R. 10 W., 1½ miles north of Camp Meeker. Some of the material has been shipped, but none in the last 10 or 15 years.

Bibl: State Mineralogist's Reports XIV, p. 334; XXII, p. 339; Bull. 38, p. 340.

[1] Diller, J. S., U. S. Geological Survey, Folio No. 138, Redding.

Occidental Deposit. An undeveloped deposit of ocherous clay just west of the hotel at Occidental.

A small deposit of soft red hematite at *Mark West Springs* has been utilized locally for paint.

Bibl: State Mineralogist's Report XXII, pp. 338, 339.

Graphite. A deposit of amorphous graphite on the *Skinner Ranch* in Sec. 14, T. 4 N., R. 7 W., 4 miles south of Petaluma, was opened in 1894 and material shipped for paint purposes, totaling $9,000 in value. Graphite suitable for paint purposes has also been noted on the *McPherson Ranch* in Secs. 13, 14, 24, 25, T. 9 N., R. 10 W., 4 miles west of Healdsburg, but undeveloped; also on Porter Creek, 10 miles southwest of Healdsburg, and an occurrence 2 miles west of Cazadero.

Bibl: State Mineralogist's Reports, VI, Pt. I, p. 111; XIV, pp. 321–322. Bull. 38, p. 281.

SISKIYOU COUNTY

In Secs. 19 and 20, T. 46 N., R. 10 W., on the north side of the *Klamath River*, runs a bed of breccia, dipping toward the river at about 45°. The cementing material is a red-ocher clay, which was used formerly by the Indians as paint.

Bibl: Cal. State Min. Bur. Bull. 38, p. 340.

STANISLAUS COUNTY

Mineral paint materials, mainly in the form of yellow ocher have been mined on a small scale in the vicinity of Knights Ferry for many years. Outcroppings occur in many places on both sides of the river, but only three properties are at present developed to the point where production can be made.

California Ocher Mining Company, address: 655 Third street, San Francisco; C. H. Kaul, manager. This property consisting of 34 acres is a part of the old Voyle holdings. The above company has owned it for the past 35 years, and has produced a large amount of ocher during that time, though operations have been intermittent, depending upon demand. The deposit is located in Sec. 17, T. 1 S., R. 12 E., and consists of a stratum of soft yellow ocher from 4 to 6 feet in thickness, in the form of a very flat anticline. It has been opened up by a number of drifts. Mining is usually done by local parties, under contract.

Bibl: State Mineralogist's Report XXI, p. 243.

Weidman Ranch Deposit. Prowse and Williams of Knights Ferry, owners. This deposit is on the south side of the river, directly apposite Knights Ferry. The ocher stratum on this property is from 4 to 6 feet in thickness. About two acres have been worked out. It has been idle for the past six years; during which time high water has filled the drifts and caved in most of the workings so that it will be necessary to run a new drift when the property is reopened.

Bibl: State Mineralogist's Report XXI, p. 243.

Voyle Mine, owner, V. J. Winkler, Knights Ferry, California. The property is in Sec. 29, T. 1 S., R. 12 E., M. D. M., on the north side of the Stanislaus River at Knights Ferry, 13 miles by paved highway east of Oakdale, the nearest railroad point. There are 60 acres in one

tract on which most of the mining has been done and another of 18 acres undeveloped. The present owner has been operating the property for the last 12 years. The deposit consists of a stratum of yellow ocher, varying from 5 to 8 feet in thickness, lying practically horizontal, with clay below. It is opened up by drifts with pillars left to support the roof. The material varies in hardness, it being quite soft in places, but the workings are dry and it stands well. Auger drills are used in mining. Operations are intermittent, depending on demand.

Bibl: State Mineralogist's Report XXI, p. 243; Bull. 38, pp. 341–342.

Winship Estate. There is a deposit of red shale in Sec. 3, T. 5 S., R. 5 E., on Hospital Creek, west of Vernalis. Undeveloped. Owner, K. D. Winship Estate, 350 Post street, San Francisco.

TRINITY COUNTY

Red ocher occurs in Sec. 15, T. 35 N., R. 8 W., on the east side of East Fork of Stuarts Fork; and Sec. 9, T. 35 N., R. 8 W.

Bibl: State Mineralogist's Report XXII, p. 63; Bull. 38, p. 342.

VENTURA COUNTY

South Mountain Deposit. Beds of soft red shale are exposed on the north slopes of South Mountain. The thickness of the beds is about 60 feet and they extend for several hundred feet. The material is of uniform brick-red color, and pulverizes readily upon crushing, leaving little or no grit.

There was a small production from this deposit in 1923. The property has been in litigation.

Bibl: State Mineralogist's Report XXI, p. 241.

YUBA COUNTY

Dempsey Ranch, in Sec. 3, T. 15 N., R. 6 E. Some development work was done several years ago. The weathered and rain beaten red ocher still on the dump gives some indication of fair quality.

Yellow ocher is exposed in small croppings in Sec. 29, T. 20 N., R. 8 E., 1 mile west of Strawberry Valley.

Bibl: State Mineralogist's Report, XV, p. 456; Bull. 38, p. 342.

MANUFACTURING PLANTS

Besides the foregoing described deposits there are two plants located on San Francisco Bay which use Californian minerals to manufacture ocher by the various mixtures of clays and iron oxides to get the desired colors.

C. K. Williams & Co. of California, located in Emeryville, Alameda County, Verne Frazee, general manager. This plant was built in 1928. They manufacture color pigments and fillers by a patented chemical process. The material is run through tube mills, buhr stones and pulverizers, chemically processed and roasted in rotary kilns. The various colors range in iron content from 5% to 95% Fe_2O_3. These products are in 15 different colors in red, yellow, brown, green and black and are marketed for stucco, cement, and mortar colors, specification pigments and fillers.

Synthetic Iron Color Co., located at Richmond, Contra Costa County, N. M. Zoph, manager. This plant was built in 1924 and has operated continuously, its capacity being 3 tons daily. The material is run through grinding and pulverizing mills, to wooden tanks which are air and steam agitated and to dryers. The product is in a variety of colors which are used for color paints, kalsomine and stucco pigments.

LIST OF PARTIES WHO HAVE ADVISED US THEY HAVE DEPOSITS OR TONNAGES OF MINERAL PAINT FOR SALE, 1922-1929.

1922

D. McDonald, Livermore.
Marvin Candle, Stacy.
J. M. Sparks, Oroville.
Harry W. Gallet, Monadnock Bldg., San Francisco.

1923

A. F. Roberts, Jackson, Amador County.
Roy Leach, Milkmaid Mine, French Gulch.
Bilstad & Chalkley, Georgetown, El Dorado County.
Mrs. Mary E. Mullally, Box 631, Escondido.
James Gavin, Forest Hill.
C. W. Casey, Applegate.
Philip Dippel, Lincoln, Placer County.
V. F. Antony, care E. H. Antony, Merchants National Bank, Los Angeles.

1924

C. J. Babcock, Box 237, Auburn.
Dr. Edward Anthony, Merchants National Bank Bldg., Los Angeles.
Dr. F. W. Green, 1635 Needham street, Modesto.
S. A. Brown, care J. W. Brewer, Box 356, Needles.

1925

J. M. Scott, P. O. Box 356, Lynwood.
A. L. Williams, Greenville.
C. F. Carew, 1627 Hudson avenue, Los Angeles.
H. H. Miner, Sanger.
J. E. Roseman, Western Hotel, Sacramento.
C. A. Cox, Box 332, Needles.

1926

C. M. Langdon, Blythe.
H. T. Overcracker, Livermore.
Ida M. Ross, Wilshire Hotel, San Francisco.

1927

Robert Erickson, 703½ J street, Sacramento.
F. L. Beverly, 506 Hibernian Bldg., Los Angeles.
T. T. Peterson, Heroult.
Charles Scott, R.R., Box 104, Oakdale.

1928

T. J. Howard, Pacific Foundation Corporation, 1017 First National Bank Bldg., San Diego.

1929

Aubrey Barney, Box 155, Elk Grove.
Chas. Schlinder, 308 E. Fifth street, Los Angeles.
Geo. W. Steele, Box 113, Colfax.
Lulu May Stone, Turpin Hotel, 17 Powell street, San Francisco.
C. W. Fisher, 4 Federal Telegraph Bldg., Oakland.
Wm. Lineback, Murphys.
J. M. McMahon, Pine and Court streets, Nevada City.
H. B. Woods, P. O. Box 111, Santa Ana.

ASSESSMENT WORK ON MINING CLAIM WITHIN WITHDRAWN AREAS

By A. H. Ricketts of the San Francisco Bar

The decision of the Court of Appeals of the District of Columbia, rendered in January, 1929, in what has been referred to as the 'Krushnic' case,[1] and which was quoted in a previous issue of Mining in California[2] has now been affirmed by the Supreme Court of the United States. The points involved are of such importance and significance to the mining claim holder that we give the decision in full herewith.[3]

"Wilbur, Secretary of the Interior, vs. *United States ex. rel. Krushnic.*

Certiorari to the Court of Appeals of the District of Columbia.

1. Under the General Mining Law, a perfected location of a mining claim has the effect of a grant by the United States of the right of present and exclusive possession, and so long as the owner complies with that law, this right, for all practical purposes of ownership, is as good as though secured by a patent. P. 316.

2. Failure to perform the annual labor (Rev. Stats. § 2324; U. S. C., Title 30, § 28) renders the claim subject to loss through relocation by another claimant, but it does not *ipso facto* forfeit the claim, and no relocation can be made if work be resumed by the owner after default and before such relocation. P. 317.

3. So far as the government is concerned, failure to perform labor in any year is without effect, and whenever $500 worth of labor in the aggregate has been performed, and the other requirements, including the payment of the purchase price, have been complied with, the owner is entitled to a patent, even though in some years annual assessment labor has been omitted. P. 317.

4. Under the Mineral Leasing Act of February 25, 1920, which, in respect of lands containing oil shale and other deposits therein specified, substituted a policy of leasing for that of location and acquisition of title, but which, by § 37, saves valid claims existent at the date of the act and 'thereafter *maintained* in compliance with the laws under which instituted,' and declares that they may be perfected under such laws, the owner of an oil shale placer claim which was valid at the date of the act but upon which no labor was performed for the assessment year in which the act was passed, 'maintains' the claim by resuming work thereon in a subsequent year, unless at least some form of challenge on behalf of the United States to the valid existence of the claim has intervened. P. 317.

5. Where the Secretary of the Interior, in declining to issue a patent for a mining claim, interprets and applies a statute in a way contrary to its explicit terms, he departs from a plain official duty, and the error may be corrected by mandamus in the Supreme Court of the District of Columbia. P. 318.

6. The writ of mandamus in this case should direct a disposal of the application for patent on its merits, unaffected by the temporary default in performance of assessment labor for the year 1920; and that further proceedings be in conformity with the views expressed in this opinion as to the proper interpretation and application of the excepting clause in the Leasing Act, and of Rev. Stats. § 2324. P. 319.

30F. (2d) 742, affirmed with modification.

"Mr. George C. Butte, Special Assistant to the Attorney General, with whom Solicitor *General Hughes,* and *Mr. E. C. Finney,* Solicitor, Department of the Interior, were on the brief, for petitioner.

"Mr. Justice Sutherland delivered the opinion of the court.

"The disposition of this case depends upon the construction and application of § 2324, R. S. (U. S. C. Title 30, § 28), and the effect upon its provisions of § 37 of the Mineral Leasing Act of February 25, 1920, c. 85, 41 Stat. 437, 451 (U. S. C. Title 30, § 193). Section 2324, R. S., which has its origin in § 5 of the Mining Act of 1872 (c. 152, 17 Stat. 91, 92), provides:

" 'On each claim located after the tenth day of May, eighteen hundred and seventy-two, and until a patent has been issued therefor, not less than one hundred dollars' worth of labor shall be performed or improvements made during each year * * * and upon a failure to comply with these conditions, the claim or mine upon which such failure occurred shall be open to relocation in the same manner as if no location of the same had ever been made, provided that the original locators, their heirs, assigns, or legal representatives, have not resumed work upon the claim after failure and before such location.'

"By § 2325, R. S. (U. S. C., Title 30, § 29), provision is made for issuing patents for claims located under the mining laws. One of the prerequisites and the only one in respect of labor, is that the claimant must show 'that $500 worth of labor has been expended or improvements made upon the claim by himself or grantors.'

"The Leasing Act of 1920 effected a complete change of policy in respect of the disposition of lands containing deposits of coal, phosphate, sodium, oil, oil shale, and gas. Such lands were no longer to be open to location and acquisition of title,

[1] 30 Fed. (2nd) 742.
[2] Ricketts, A. H., in State Mineralogist's Report XXV, pp. 378–386, July, 1929.
[3] 280 U. S., 306–319; decided Jan. 6, 1930.

but only to lease. But § 37 (U. S. C. Title 30, § 193) contains a saving clause protecting 'valid claims existent at date of the passage of this act and thereafter maintained in compliance with the laws under which initiated,' and declaring that they 'may be perfected under such laws, including discovery.'

"On October 1, 1919, respondent and seven associates, all qualified under the law, located a tract of land in Garfield County, Colorado, under the name of Spad No. 3 placer claim. The land contained valuable deposits of oil shale and was open to appropriation under the mining laws of the United States. Spad No. 3 placer claim formed one of a group of six oil placer claims, numbered Spad No. 1, 2, 3, 4, 5 and 6 respectively, all located and owned by the same persons, and lying adjacent to each other. The assessment year 1920, by act of Congress, was extended until July 1, 1921. Prior to that date, annual labor amounting in value, it was asserted, to more than $600 was performed on claims numbered 4, 5 and 6, with the intention that said labor should apply to the entire group.

"Subsequently, respondent acquired the interest of his co-locators in the Spad No. 3, and, during and for the assessment year 1921, performed thereon assessment labor of an admitted value of more than $100, and continued to perform labor and make improvements on the claim until the aggregate value exceeded $500. On September 25, 1922, he applied for a patent, and, having complied with the statutory requirements and paid the purchase price, obtained final receiver's receipt on December 16, 1922. No relocation of the claim was ever attempted, nor was the valid existence or maintenance of the claim ever challenged in anywise by the United States, or by anyone, prior to the issue of the receiver's receipt. Thereafter, a proceeding against the entry was instituted by the Commissioner of the General Land Office; and that officer, after consideration, held the claim null and void upon the sole ground of insufficient assessment labor for the year 1920. This holding was affirmed by the Secretary of the Interior.

Opinion of the Court

"In all the proceedings before the land officers and the Secretary it was conceded, as it is here conceded, that the claim was valid and existent when the Leasing Act was passed; and that no reason existed, or now exists, for withholding a patent, save the alleged failure of assessment labor for the assessment year 1920. The Secretary held that by such failure, all rights to the claim became extinguished and could not be saved or revived by a resumption of work.

"Thereupon, respondent applied by petition to the Supreme Court of the District of Columbia for a writ of mandamus to compel the Secretary to issue a patent to the claim. After a hearing on rule to show cause, that court discharged the rule and dismissed the petition. Upon appeal this judgment was reversed by the Court of Appeals for the District. 30F (2d) 742.

"Two questions are presented for determination: (1) Did the Leasing Act of 1920 have the effect of extinguishing the right of the locator, under § 2324, to save his claim under the original location by resuming work after failure to perform annual assessment labor? (2) Is the case a proper one for a case of mandamus?

"1. The rule is established by innumerable decisions of this court, and of state and lower federal courts, that when the location of a mining claim is perfected under the law, it has the effect of a grant by the United States of the right of present and is 'real property' subject to the lien of a judgment recovered against the and may be sold, transferred, mortgaged, and inherited without infringing any right or title of the United States. The right of the owner is taxable by the state; and exclusive possession. The claim is property in the fullest sense of that term; owner in a state or territorial court. *Belk* vs. *Meagher*, 104 U. S. 279, 283; *Manuel* vs. *Wulff*, 152 U. S. 505, 510–511; *Elder* vs. *Wood*, 208 U. S. 226, 232; *Bradford* vs. *Morrison*, 212 U. S. 389. The owner is not required to purchase the claim or secure patent from the United States; but so long as he complies with the provisions of the mining laws, his possessory right, for all practical purposes of ownership, is as good as though secured by patent. While he is required to perform labor of the value of $100 annually, a failure to do so does not *ipso facto* forfeit the claim, but only renders it subject to loss by relocation. And the law is clear that no relocation can be made if work be resumed after default and before such relocation.

"Prior to the passage of the Leasing Act, annual performance of labor was not necessary to preserve the possessory right, with all the incidents of ownership above stated, as against the United States, but only as against subsequent relocators. So far as the government was concerned, failure to do assessment work for any year was without effect. Whenever $500 worth of labor in the aggregate had been performed, other requirements aside, the owner became entitled to a patent, even though in some years annual assessment labor had been omitted. *P. Wolenberg et al.*, 29 L. D. 302, 304; *Nielson* vs. *Champagne Mining & M. Co.*, 29 L. D. 491, 493.

"It being conceded that the Spad No. 3 'was a valid claim existent on February 25, 1920,' the only question is whether, within the terms of the excepting clause of § 37, the claim was 'thereafter maintained in compliance with the laws under which initiated.' These words are plain and explicit, and we have only to expound them according to their obvious and natural sense.

"It is not doubted that a claim initiated under § 2324, R.S., could be maintained by the performance of annual assessment work of the value of $100; and we think it is no less clear that after failure to do assessment work, the owner equally maintains his claim, within the meaning of the Leasing Act, by a resumption of work, unless at least some form of challenge on behalf of the United States to the valid existence of the claim has intervened; for as this court said in *Belk* vs. *Meagher, supra*, at page 283, 'His rights after resumption were precisely what they would have been if no default (that is, no default in the doing of assessment labor) had occurred.' Resumption of work by the owner, unlike a relocation by him, is an act not in derogation but in affirmance of the original location; and thereby the claim is 'maintained' no less than it is by performance of the annual assessment labor. Such resumption does not *restore* a *lost* estate—see *Knutson* vs. *Fredlund*,

56 Wash., 634, 639; it *preserves* an *existing* estate. We are of the opinion that the Secretary's decision to the contrary violates the plain words of the excepting clause of the Leasing Act.

"2. While the decisions of this Court exhibit a reluctance to direct a writ of mandamus against an executive officer, they recognize the duty to do so by settled principles of law in some cases. *Lane* vs. *Hoglund*, 244 U. S. 174, 181, and cases cited. In *Roberts* vs. *United States*, 176 U. S. 221, 231, referred to and quoted in the *Hoglund* case, this court said:

" 'Every statute to some extent requires construction by the public officer whose duties may be defined therein. Such officer must read the law, and he must therefore, in a certain sense, construe it, in order to form a judgment from its language what duty he is directed by the statute to perform. But that does not necessarily and in all cases make the duty of the officer anything other than a purely ministerial one. If the law direct him to perform an act in regard to which no discretion is committed to him, and which, upon the facts existing, he is bound to perform, then that act is ministerial, although depending upon a statute which requires, in some degree, a construction of its language by the officer. Unless this be so, the value of this writ is very greatly impaired. Every executive officer whose duty is plainly devolved upon him by statute might refuse to perform it, and when his refusal is brought before the court he might successfully plead that the performance of the duty involved the construction of a statute by him, and therefore it was not ministerial, and the court would on that account be powerless to give relief. Such a limitation of the powers of the court, we think, would be most unfortunate, as it would relieve from judicial supervision all executive officers in the performance of their duties, whenever they should plead that the duty required of them arose upon the construction of a statute, no matter how plain its language, nor how plainly they violated their duty in refusing to perform the act required.'

"See, also, *Ballinger* vs. *Frost*, 216 U. S. 240, 250.

"In this case, the Secretary interpreted and applied a statute in a way contrary to its explicit terms, and in so doing, departed from a plain official duty. A writ of mandamus should issue directing a disposal of the application for patent on its merits, unaffected by the temporary default in the performance of assessment labor for the assessment year 1920; and that further proceedings be in conformity with the views expressed in this opinion as to the proper interpretation and application of the excepting clause of the Leasing Act of February 25, 1920, and of § 2324, Revised Statutes of the United States. A writ in that form follows the precedent established by this court in respect of the writ of injunction in *Payne* vs. *Central Pac. Ry. Co.*, 255 U. S. 228, 238; and *Payne* vs. *New Mexico*, 255 U. S. 367, 373, as being better suited to the occasion than that indicated by the District Court of Appeals. As so modified the judgment of that court is

Affirmed."

ADMINISTRATIVE

WALTER W. BRADLEY, State Mineralogist

Personnel.

There have been no changes nor additions of personnel to be noted during the past three months.

New Publications.

Summary of Operations, California Oil Fields, Vol. 14, Nos. 9, 10, and 11, March, April, May, 1929, respectively, containing the following special articles: (March), "Uniform Penetration in Orderly Development of Oil Zones"; (April), "A General Discussion of Natural Gas Technology"; (May), "Controlling a Blow-out in the Kettleman Hills Field."

Commercial Mineral Notes, Nos. 82, 83, 84, January, February, March, 1930, respectively. These 'notes' contain the lists of 'mineral deposits wanted' and 'minerals for sale' issued in the form of a mimeographed sheet, monthly. It is mailed free to those on the mailing list for MINING IN CALIFORNIA.

Mails and Files.

The Division of Mines maintains, in addition to its correspondence files and the library, a mine file which includes original reports on the various mines and mineral properties of all kinds in California.

During each quarterly period there are several thousand letters received and answered at the San Francisco office alone, covering almost every phase of prospecting, mining and developing mineral deposits, reduction problems, marketing of refined products and mining law. In addition to this, hundreds of oral questions are answered daily, both at the main office and the district offices, for the many inquirers who come in for personal interviews and to consult the files and library.

MINERALS AND STATISTICS

Statistics, Museum, Laboratory

HENRY H. SYMONS, Statistician and Curator

STATISTICS

California continues to produce commercially, as for some years, more than 50 different mineral substances, the total value of which for 1929 was estimated at $398,018,000 (see January issue, 'Mining in California,' page 73).

At present writing (April, 1930) reports are in hand for most of the producers. Data for several substances are now complete and have been compiled, being presented herewith.

Information at hand indicates that there was no production during 1929 of the following substances, which have at one time or another in the past been on the active list here: antimony, arsenic, bismuth, fluorspar, iron ore, lithia, molybdenum, serpentine, strontium and titanium. There was production by a single operator in each of the following: andalusite, asbestos, bromine, cyanite, mica, potash, sulphur, tin and zinc. There were recorded commercial shipments of sericite schist (mica) and sulphur this year. This is the first record of mining of sericite, as such, in California. Sulphur as been mined in the past in several places, but actually there had been no shipments for several years.

BARYTES

Commercial shipments of crude barytes in California in 1929 amounted to a total of 26,796 short tons valued at $168,829 f.o.b. rail shipping point, being an increase in both quantity and value over the 1928 figures, which were 13,406 short tons and $55,888. The 1929 yield came from a single property in each Mariposa, Nevada and Santa Barbara counties and two properties in San Bernardino County. This material was consumed in the manufacture of lithopone, as heavy-gravity oil-well drilling mud and barium chemicals. The mining of barytes has been showing a steady increase, with 1929 showing the largest annual production.

Known occurrences of this mineral in California are located in Inyo, Los Angeles, Mariposa, Monterey, Nevada, San Bernardino, Shasta and Santa Barbara counties. The deposit at El Portal, in Mariposa County, has given the largest commercial production to date, in part witherite (barium carbonate, $BaCO_3$). Witherite has also been found in Shasta County, but no shipments have yet been made from the deposit.

BITUMINOUS ROCK

This material is essentially an uncemented sandstone which is saturated with and held together by natural asphaltic constituent, probably the residue from the evaporation of a crude petroleum deposit. Bituminous rock is still used to a limited extent for road dressing in those districts adjacent to available deposits, though the manufacture of asphalt at the oil refineries has almost entirely superseded the direct use of the native material. Some of the Santa Cruz County produc-

tion is put on the market as a material which can be laid cold. This material is especially applicable and valuable for patch jobs.

Shipments from quarries in Santa Barbara and Santa Cruz counties in 1929 totaled 3320 tons of bituminous rock valued at $14,360 f.o.b. railroad. This was a decrease both in quantity and value from the 1928 production, which was 4966 tons and $33,832.

BORATES

During 1929 there was produced in California a total of 162,059 tons of borate materials, compared with 123,761 tons for the year 1928. The material shipped during the year included crude and select colemanite ore from Inyo County, the new sodium borates, kernite (rasorite), kramerite and some colemanite from Kern County; also crystallized borax prepared by evaporation of brines at Searles Lake in San Bernardino County.

As the crude ore is not sold as such, but is almost entirely calcined before shipping to the refinery for conversion into the borax of commerce, and because of the fact that the material varied widely in boric acid content, we have recalculated the tonnage to a basis of 40%, A. B. A. This is approximately the average A. B. A. content of the colemanite material after calcining, and also of the crystallized borax obtained from evaporation of the lake brines.

Recalculated as above, the 1929 production totals 144,678 tons, valued at $3,312,085, being an increase in quantity but having a decreased value from the similar figures for 1928, which were 109,722 tons and $3,378,552.

CEMENT

Cement is the most important single structural material in the mineral output of California. During 1929 there was a total of 12,794,729 barrels shipped, valued at $21,038,565 f.o.b. plant, being a decrease in both quantity and value. The 1928 output was 13,625,231 barrels valued at $24,463,287 or an average of $1.79 per barrel. The 1929 average value was $1.64 per barrel. Production came from eleven operating plants in nine counties and employing a total of 2220 men. Three plants in San Bernardino County made a total of 3,576,005 barrels valued at $4,603,361, the balance of the state's production coming from a single plant in each of the following counties: Calaveras, Contra Costa, Kern, Merced, Riverside, San Benito, San Mateo and Santa Cruz.

CHROMITE

Chrome iron ore or chromite to the amount of 327 short tons recalculated to the basis of 45% Cr_2O_3 valued at $5,025 f.o.b. shipping point was sold in California during 1929. This was a decrease from the 1928 production, which was 729 tons valued at $15,179. This material came from San Luis Obispo, Shasta, Sonoma, Tehama and Trinity counties with a single operator in each. The grade varied from 37% to 50% Cr_2O_3. About half of the above material was mined during the year, the remainder having been mined during the World War period but not sold then.

It is hoped that the development of the steel industry and the resumption of copper smelting on the Pacific coast may create some demand for California's chromite, but the outlook for the immediate future is not encouraging.

DOLOMITE

The production of dolomite in California for the year 1929 totaled 58,644 tons valued at $156,928, being an increase in both quantity and value over the 1928 figures, which were 38,739 tons at $85,342. The 1929 output came from a single quarry each in Inyo, Monterey and Tuolumne counties. The material shipped was utilized for steel furnace flux and refractories, and for manufacture of CO_2. Some previously has been used for burned dolomitic lime, for stucco dash-coat, and terrazzo.

FELDSPAR

Feldspar was produced by five operators in three counties in California (Imperial, Riverside and San Diego) during 1929 to the amount of 13,327 short tons valued at $78,404. This was a decrease in both quantity and value as compared with the 1928 figures, which were 14,628 tons and $93,745.

The requirements of the pottery trade demand that in general the percentage of free silica associated with the feldspar be less than 20%, and in some cases the potters specify less than 5%. An important factor, also, is the iron-bearing minerals frequently present in pegmatites and granites, such as biotite (black mica), garnet, hornblende and black tourmaline. Feldspar for pottery uses should be practically free of these. The white, potash-mica, muscovite, is not particularly objectionable except that being in thin, flexible plates, it does not readily grind to a fineness required for the feldspar.

GEMS

The production of gem materials in California has been somewhat irregular and uncertain since 1911. The compilation of complete statistics is difficult owing to widely scattered places at which stones are gathered and marketed, for the most part in a small way. The gem material reported in California in 1929 totaled $26,850 in value compared with $22,200 in 1928. This increase is due to the demand for quartz crystals for optical uses and radio and in a smaller way to costume jewelry.

The following table shows the distribution of rough, uncut gems and jewelry material during 1929:

County	*Value*	*Kind*
Butte	$550	Diamond, California jade and precious serpentine.
San Bernardino	1,540	Agate, bloodstone, blue chalcedony, iceland spar, jasper, myrickite, rose-quartz and topaz.
San Diego	2,210	Kunzite, beryl, quartz, spessatite garnet, tourmaline and topaz.
Calaveras	* 22,550	Quartz crystals.
Fresno		Topaz and green tourmaline.
Inyo		Agate.
Lake		Amethyst, quartz, topaz.
Sonoma		Hyalite (Sonomite).
Total	$26,850	

* Combined to conceal output of a single operator in each.

MAGNESITE

The production of magnesite in California during 1929 amounted to a total of 47,269 tons crude ore valued at $488,014. Only a very small part of it was sold 'crude,' however, as it was practically all shipped in the calcined form. The reports at hand show a total of 20,661 tons shipped calcined valued at $663,224 rail shipping point; of this about

25% was dead-burned for refractory purposes, the balance going to the plastic trade. This material came from San Benito, Santa Clara, Stanislaus and Tulare counties with a single producer in each. From 2 to 2½ tons of crude material are mined to make one ton of calcined. The 1929 output showed a decreased value, although there was a slight increase in quantity over the 1928 figure, which was 45,645 tons crude valued at $501,590. The average of the values reported for 1929 is $10.32 per ton compared with $11 in 1928 and $12.50 in 1927.

MANGANESE

Manganese ore shipments in California during the years 1928 and 1929 amounted to a total of 733 short tons valued at $8,216. The 1929 production came from Plumas, San Bernardino and Stanislaus counties with a single producer in each. The 1928 production was combined to conceal the output of either of two operators that year and was somewhat less both in quantity and value than the shipments in 1929. These ores showed analyses from 42% to 52% Mn and were utilized as an alloy in steel and for the manufacture of fertilizer.

MINERAL PAINT

Mineral paint materials were produced in California in 1929 from a single operator each in Alameda, Placer and Stanislaus counties, amounting to 467 short tons valued at $2,820. This was a decrease in both quantity and value from the 1928 production, which was placed under 'unapportioned' to conceal the output of either of the two operators of that year.

PUMICE AND VOLCANIC ASH

The production of pumice and volcanic ash in California for the year 1929 amounted to 10,449 short tons valued at $76,123 coming from two operators in Fresno County and a single property each in Kern, Imperial, Inyo, Mono, San Bernardino and San Luis Obispo counties. The 1929 tonnage was approximately the same as the 1928, but showed a decreased value. The 1928 figures were 10,440 tons and $105,055.

The material from Imperial and Inyo and a portion from Mono is the vesicular, block variety and was sold for abrasive purposes. The balance of the Mono material and that from Fresno, Kern and San Luis Obispo was the volcanic ash, or tuff variety, and was employed in making soap, cleanser compounds, and a large tonnage is being utilized as a concrete filler in cement displacement. The Kern County ash is going into the preparation of one of the popular and nationally advertised brands of cleanser compounds.

PYRITES

A total production of 79,169 tons of pyrite valued at $363,717 was reported shipped in California during 1929, from properties in Alameda and Shasta counties. This was a decrease both in quantity and value from the 1928 figures of 90,566 tons and $400,627.

The material was mostly used in the manufacture of sulphuric acid for explosives and fertilizers, but a portion was utilized directly in the preparation of agricultural fertilizer and insecticide. The sulphur content ranged up to 46.5% S.

This does not include the large quantities of pyrite, chalcopyrite, and other sulphides which are otherwise treated for their valuable metal contents. Some sulphuric acid is annually made as a by-product in the course of roasting certain tonnages of Mother Lode auriferous concentrates while under treatment for their precious metal values.

QUICKSILVER

The production of quicksilver for 1929 in California was 10,152 flasks (of 76 pounds avoirdupois) valued at $1,195,705. This was an increase both in quantity and value over the 1928 production, which was 7107 flasks (76 pounds) and $844,649. The 1929 production came from Colusa, Fresno, Kern, Lake, Napa, Orange, San Benito, San Luis Obispo, Santa Clara, Siskiyou, Sonoma and Trinity counties.

During 1929, the average monthly quotations were over $122 with the highest in August with an average of $126 for a 76-pound flask. In June, 1927, the price quotations changed from a 75-pound flask to a 76-pound flask. The average price received during 1929 according to the producers' report to the Division of Mines was $117.78 per 76-pound flask, as compared to $118.84 received in 1928 which was also the highest record average.

The average quotation for quicksilver in 1929 was $123.97 for 76-pound flask at San Francisco compared with $125 (76-pound flask) in 1928, $117.25 (76-pound flask) in 1927 and $87.64 (75-pound flask) in 1926.

Distribution of the 1929 output of quicksilver by counties was as follows:

County	*Flasks*	*Value*
Lake	1,697	$203,247
Napa	2,081	246,747
San Luis Obispo	1,076	120,995
Colusa, Fresno, Kern, Orange, San Benito, Santa Clara, Siskiyou, Sonoma and Trinity*	5,298	624,696
Totals	10,152	$1,195,705

* Combined to conceal the output of a single operator in each.

SALT

Most of the salt production in California is obtained by evaporating the water of the Pacific Ocean, plants being located on the shores of San Francisco, Monterey and San Diego bays, and at Long Beach. Additional amounts are derived from lakes and lake beds in the desert regions, mainly in Inyo, Kern and San Bernardino counties, and evaporation of alkaline lake water in Modoc County. A small amount of valuable medicinal salts is obtained by evaporation of the water of Lake Mono, Mono County.

During 1929 in California there was a production of 392,039 short tons of salt valued at $2,665,436, being an increase over the 1928 figures which were 340,580 tons and $1,024,656. There were sixteen plants operating in 1929, four of which were in Alameda County, two each in San Bernardino and San Mateo counties and one in Inyo, Kern, Los Angeles, Modoc, Mono, Monterey, San Diego and Santa Clara counties.

SILICA (SAND AND QUARTZ)

The production of silica in California in 1929 amounted to 18,686 tons, valued at $79,210 from nine properties in eight counties, Contra Costa, El Dorado, Imperial, Mariposa, Monterey, Placer, Riverside and

San Diego. This was an increase from 14,814 tons valued at $66,679. in 1928. Of the above total 9,656 tons was of sand and 8,530 tons of vein and boulder quartz. For making the higher grades of glass, most of the sand is imported from Belgium. Belgium sand has also displaced local material in the manufacture of sodium silicate (water glass). There are various deposits of quartz in California which could be utilized for glass making, but to date they have not been so used, owing to the cost of grinding and the difficulty of preventing contamination by iron while grinding.

Silica sand has been produced in the following counties of the state: Alameda, Amador, Contra Costa, El Dorado, Los Angeles, Mono, Monterey, Orange, Placer, Riverside, San Diego, San Joaquin, and Tulare, the chief centers being Amador, Monterey and Los Angeles counties. The industry is of limited importance, so far, because of the fact that much of the available material is not of a grade which will produce first-class colorless glass; for such, it must be essentially iron-free. Even a fractional per cent of iron imparts a green color to the glass.

SOAPSTONE AND TALC

The total output of talc and soapstone in California in 1929 amounted to 18,652 tons valued at $193,397. Although the tonnage was approximately the same, the value showed a decrease from the 1928 output, which was 18,668 tons and $251,372. Over 75% of the product was high-grade talc from Inyo and San Bernardino counties, which material was utilized mainly in toilet powders, paint, paper and rubber manufacture, and some in ceramics. The remainder came from Butte and El Dorado counties, being soapstone, with some of the El Dorado material, a steatite variety, used in making electrical insulators. Inyo County has three producers, Butte and San Bernardino counties, two producers each, El Dorado County a single producer.

The 'soapstone' grades were used mainly for roofing granules and as a filler in roofing paper, and part also in magnesite cement.

Californian talc is competing successfully with imported talc in the toilet trade on the basis of quality. The largest production of talc in the United States comes from Vermont and New York, and of massive soapstone from Virginia.

SODA

The production of sodium salts in California in 1929 included: soda ash, trona, caustic soda and bicarbonate from plants at Owens Lake, Inyo County, and trona (sesqui-carbonate), a double salt of Na_2CO_3 and $NaHCO_3$ from Searles Lake, San Bernardino County. There were no shipments of salt cake (sulphate) from the Carrizo Plains, San Luis Obispo County, in 1929. The total for the year amounted to 90,646 tons, valued at $1,838,657, being an increase in both quantity and value compared with the 1928 figures which were 80,838 tons and $1,469,916.

The dense ash and bicarbonate were used mainly in the manufacture of soap, glass, sugar refining, and chemicals; and the trona for metallurgical purposes.

Sodium compounds to some extent replace potassium compounds, in glass and soap making, in photography, in match making, in tanning, sugar refining, and in the manufacture of cyanide for extracting gold and silver from their ores.

MUSEUM

The museum of the State Division of Mines possesses an exceptionally fine collection of rocks and minerals of both economic and academic value. It ranks among the first five of such collections in North America; and contains not only specimens of most of the known minerals found in California, but much valuable and interesting material from other states and foreign countries as well.

About the middle of February the Mariposa Mines Association loaned the Division of Mines nineteen pieces of very rich gold quartz carrying about $5,000 in gold from the Spread Eagle Mine of the Whitlock Mining Corporation located six miles from the town of Mariposa in Mariposa County, California. The largest piece was about 24 inches long, 12 inches wide and 4 inches thick, showing free gold throughout the whole specimen. The other pieces varied from about a foot square and 5 inches thick to the size of a man's fist and equally as rich as the largest specimen. They attracted considerable attention, and after being on exhibit for about six weeks, were returned to the Whitlock Mining Corporation.

Mineral specimens suitable for exhibit purposes are solicited, and their donation will be appreciated by the State Division of Mines as well as by those who utilize the facilities of the collection.

The exhibit is daily visited by engineers, students, business men, and prospectors, as well as tourists and mere sightseers. Besides its practical use in the economic development of California's mineral resources, the collection is a most valuable educational asset to the state and to San Francisco.

LABORATORY

FRANK SANBORN, Mineral Technologist

Beryllium and its compounds closely resemble those of aluminum. Beryl, the chief source of beryllium, is found in California and, so far as known, is limited chiefly to the series of feldspathic pegmatite veins of Riverside and San Diego counties. It is also said to occur about five miles north of Trimmer in Fresno County and in the northern part of San Bernardino County. Occurrences reported in El Dorado and Tuolumne counties are probably vesuvianite.

Some clays, especially those of the montmorillonite group, may prove to contain beryllium in sufficient amounts to be of commercial importance. The fact that these clays are usually acid-soluble may be of a great advantage in the extraction of this element if it should be present. It has been reported that a clay deposit near Needles contains about 2 per cent beryllium. If this proves to be correct, a new prospecting field will be opened in this state.

LIBRARY

HERBERT A. FRANKE, Librarian

In addition to the numerous standard works, authoritative information on many phases of the mining and mineral industry is constantly being issued in the form of reports and bulletins by various government agencies.

The library of the Division of Mines contains some five thousand selected volumes on mines, mining and allied subjects, and it is also a repository for reports and bulletins of the technical departments of federal and state governments and of educational institutions, both domestic and foreign.

It is not the dearth of the latter publications, but rather a lack of knowledge of just what has been published and where the reports may be consulted or obtained, that embarrasses the ordinary person seeking specific information.

To assist in making the public acquainted with this valuable source of current technical information, MINING IN CALIFORNIA contains under this heading a list of all books and official reports and bulletins received, with names of publishers or issuing departments.

Files of all the leading technical journals will be found in the library, and county and state maps, topographical sheets and geological folios. Current copies of local newspapers published in the mining centers of the state are available for reference.

The library and reading room are open to the public during the usual office hours, when the librarian may be freely called upon for all necessary assistance.

OFFICIAL PUBLICATIONS RECEIVED

Governmental.

U. S. Geological Survey:

Professional Papers:

154 —Shorter Contributions to General Geology. 1928.

158–I—Borate Minerals from the Kramer District, Mohave Desert, California. By W. T. Schaller.

165–A—Lithologic Studies of Fine-grained Upper Cretaceous Sedimentary Rocks of the Black Hills Region. By W. W. Rubey.

165–B—A Flora of Green River Age in the Wind River Basin of Wyoming. By E. W. Berry.

Bulletins:

811–A—The New World or Cooke City Mining District, Park County, Montana. By T. S. Lovering.

811–C—Indiana Oolitic Limestone. By C. F. Loughlin.

812–C—Geology and Coal Resources of the Meeker Quadrangle, Moffat and Rio Blanco Counties, Colorado.

812–D—Geology and Oil Resources Along the Southern Border of San Joaquin Valley, California. By H. W. Hoots.

813–A—Mineral Industry of Alaska in 1928 and Administrative Report. By P. S. Smith.

813–C—Mining in the Fortymile District, Alaska. By J. B. Mertie, Jr.

816 —Geology of the Eagle-Circle District, Alaska. By J. B. Mertie, Jr.

822–B—The Granby Anticline, Grand County, Colorado. By T. S. Lovering.

Monograph:

No. 55, Volumes 1 and 2—Titanotheres of Ancient Wyoming, Dakota and Nebraska. By H. F. Osborn.

Water Supply Papers:

597 —Contributions to the Hydrology of the U. S., 1928. By N. C. Grover.
601 —North Atlantic Slope Drainage Basins.
606 —Part VI, Missouri River Basin.
617 —Upper Colorado River and its Utilization. By R. Follansbee.
619 —Geology and Water Resources of the Mokelumne Area, California. By H. T. Stearns, T. W. Robinson and G. H. Taylor.
621 —Part I, North Atlantic Slope Drainage Basins.
624 —Part IV, St. Lawrence River Basin.
625 —Part V, Hudson Bay and Upper Mississippi River Basins.
626 —Part VI, Missouri River Basin.
627 Part VII, Lower Mississippi River Basin.
636–C—The New England Flood of November, 1927. By H. B. Kinnison.
636–D—Surface Water Supply of the San Joaquin River Basin, California, 1895–1927. By H. D. McGlashan.
636–E—Surface Water Supply of Pacific Slope Basins in Southern California, 1894–1927. By H. D. McGlashan.
636–F—Water-Power Resources of the Umpqua River and its Tributaries, Oregon. By B. E. Jones and H. T. Stearns.
637–A—Surface Water Supply of Minor San Francisco Bay, Northern Pacific and Great Basins in California, 1895–1927. By H. D. McGlashan.

U. S. Coast and Geodetic Survey:

468 —Seismological Report, 1927.
455 —Results of Magnetic Observations in 1928.

U. S. Bureau of Mines:

Technical Papers:

455 —Analyses of Kansas Coals.
459 —Effect of Sized Ore on Blast-Furnace Operation. By S. P. Kinney.
461 —Salvage of Material in the Oil Industry. By C. P. Bowie.
465 —Analyses of Maryland Coals. By E. B. Mathews.
466 —Effect of Manganese on Distribution of Carbon in Steel. By B. M. Larsen.
467 —Production of Explosives in the U. S., 1928. By W. W. Adams and L. S. Gerry.
468 —Coke-Oven Accidents in the U. S., 1928. By W. W. Adams and L. Chenoweth.
471 —How Leakage of Current from an Electric Shot-Firing Circuit Causes Misfires. By L. C. Ilsley, A. B. Hooker and D. H. Zellers.
474 —Accidents at Metallurgical Works in the U. S. By W. W. Adams.

Bulletins:

Annual Report of the Director of the Bureau of Mines, ended June 30, 1929.
280 —Petroleum Refinery Statistics, 1916–1925.
301 —Facts Relating to the Production and Substitution of Manufactured Gas for Natural Gas.
306 —Mining Methods and Practice in the Michigan Copper Mines. By W. R. Crane.
307 —Flow of Gases Through Beds of Broken Solids. By C. C. Furnas.
311 —Drilling and Blasting in Metal-Mine Drifts and Crosscuts. By E. D. Gardner.
316 —Commercial Possibilities of the Texas-New Mexico Potash Deposits. By J. S. Wroth.
319 —Coal Mine Fatalities in the U. S., 1928. By W. W. Adams.

Mineral Resources:

Abrasive Materials in 1928. By O. Bowles.
Asbestos in 1928. By O. Bowles and B. H. Stoddard.
Barite and Barium Products in 1928. By R. M. Santmyers and B. H. Stoddard.
Gold, Silver, Copper, Lead and Zinc in Montana in 1927. By C. N. Gerry
Gold, Silver, Copper, Lead and Zinc in Oregon in 1928. By V. C. Heikes.
Gypsum in 1928. By R. M. Santmyers and J. Middleton.
Lead and Zinc Pigments and Salts in 1928. By E. W. Pehrson.
Lime in 1928. By A. T. Coons.
Manganese and Manganiferous Ores in 1928. By T. A. Smith.
Mercury in 1928. By P. M. Tyler.
Natural Gasoline in 1928. By G. R. Hopkins and E. M. Seeley.
Phosphate Rock in 1928. By B. L. Johnson.
Platinum and Allied Metals in 1928. By V. C. Heikes.
Rare Metals. By F. T. Heiss.
Sand and Gravel in 1928. By E. R. Phillips.
Secondary Metals in 1928. By J. P. Dunlop.
Silica in 1928.
Silver, Copper, Lead and Zinc in the Central States in 1928. By J. P. Dunlop and H. M. Meyer.
Slate in 1928. By O. Bowles and A. T. Coons.
Stone in 1928. By A. T. Coons.
Sulphur and Pyrites in 1928. By R. H. Ridgeway.
Talc and Soapstone in 1928. By O. Bowles and B. H. Stoddard.
Tin in 1928. By C. W. Merrill.
Zinc in 1928. By E. W. Pehrson.

Economic Papers:

5—Summarized Data of Lead Production. By L. A. Smith.
7—Economics of New Sand and Gravel Developments. By J. R. Thoenen.

Miner's Circulars:

34—Instructions in Methods of Sampling and in the Use of the Bureau of Mines Portable Orsat Apparatus for Analyzing Mine Gases. By W. B. Yant and L. B. Berger.

Reports of Investigations:

2968—Xylenols and Higher Phenols That Have Been Found in Primary Tars. By E. J. Schneider and J. B. Shohan.
2977—Rock-Dust Barriers for Coal Mines. By G. S. Rice, H. P. Greenwald, and H. C. Howarth.
2982—Method for Comparison of the Size of Materials Used in Blast Furnace Burdens. By S. P. Kinney.
2983—Ore Size and Blast-Furnace Economy. By S. P. Kinney.
2984—A Diaphragm or "Breather" Roof for Oil-Storage Tanks. By Ludwig Schmidt.

(Describes design and operation of a new type of tank roof which practically eliminates the movement of air-vapor mixtures from an oil storage tank and is of especial value on tanks storing oil over long periods.)

2985—The Form of Copper in Converter Slag. By F. S. Wartman and W. T. Boyer.
2986—Experience with Electrical and Other Means of Firing Shots of Explosives in the Anthracite Region of Pennsylvania. By S. P. Howell.
2987—Sensitization of Ammonium Nitrate by Nitrostarth. By G. St. J. Perrott, D. B. Gawthrop, and C. A. Taylor.
2988—Official Changes in the Active List of Permissible Explosives and Blasting Devices for February, 1930.
2989—Grinding and Classification. I.—Batch Grinding. By A. W. Fahrenwald.

(Describes a batch-grind technic designed for studying the rate of output of finished product in a ball mill.)

2990—Grinding and Classification. II.—Batch Closed-Circuit Grinding. By A. W. Fahrenwald.

(A laboratory closed-circuit technic designed to stimulate plant closed-circuit grinding practice is outlined, and numerous experimental data are given.)

2991—Cracking Natural Gas in Water-Gas Generators With Recovery of Carbon Black. By Wm. W. Odell.

2992—Official Changes in the Active List of Permissible Explosives and Blasting Devices for March, 1930.

2995—Twenty-first Semiannual Motor Gasoline Survey. By E. C. Lane, E. L. Garton, and O. C. Blade.

Information Circulars:

6215—Caesium, Rubidium, and Lithium. By R. M. Santmyers.

(Describes the minerals and ores and gives tests for identification. Presents data on uses, sources, imports and exports, and markets and prices. Contains list of producers, dealers, and purchasers. Bibliography.)

6217—Bureau of Mines Instruction in First Aid, and Value of 100 Per Cent First-Aid Training to Employees of Mining and Oil Companies.

6219—Mining Laws of Spain. By E. P. Youngman.

6221—Barite and Barium Products. Part I, General Information. By R. M. Santmyers.

6222—List of Manufacturers of Permissible Equipment and Explosion-Proof Accessories, as of January 1, 1930. By L. C. Ilsley.

6223—Barite and Barium Products. Part II.—Barium Products. By R. M. Santmyers.

(Completes the history of barite and barium products. Deals especially with the preparation, uses, production, marketing, and imports and exports of ground barite, lithopone, and barium chemicals.)

6225—Reducing Accidents from Falls of Roof in Coal Mines.

6226—Automatic Derailing Switch at Roslyn No. 3 Mine, Northwestern Improvement Co., Roselyn, Wash. By S. H. Ash and Rudolf H. Kudlich.

6227—Activity of the Holmes Safety Association in Reducing Accidents in Alabama. By C. E. Saxon and C. W. Owings.

6228—Railroad Fuel Oil Consumption in 1928. By Arthur H. Redfield.

6229—Teaching Safety Through the Approval Plate. By L. C. Ilsley.

6230—List of Permissible Mining Equipment. January, 1930. By the electrical section, Pittsburg Experiment Station.

6231—Mining Laws of France. By E. P. Youngman.

6232—Mining Methods and Costs at the Hecla and Star Mines, Burke, Idaho. By C. H. Foreman.

6233—Geophysical Abstracts No. 9. By F. W. Lee.

(Continues a series of publications presenting brief summaries of outstanding articles on the development and application of geophysical methods of prospecting.)

6234—Mining Methods and Costs of the Utah Copper Co., Bingham Canyon, Utah. By A. Soderberg.

6235—Comparative Advantages of Applying Several Geophysical Methods of Prospecting to the Same Territory. By F. W. Lee.

6236—Milling Practice at the Alaska Juneau Concentrator. By P. R. Bradley.

(The first of a new series of reports describing milling methods and costs in the various districts of the United States. Includes flow sheets and a general description of plant.)

6237—Mining Methods at the Old Dominion Mine, Globe, Arizona. By A. H. Shoemaker.

6238—Mining Methods at the Morning Mine of the Federal Mining and Smelting Co., Mullan, Idaho. By C. E. Wethered and Leo. J. Coady.

6239—Mining Methods and Costs, American Zinc Co., of Tennessee, Mascot, Tenn. By Harley A. Coy.

6240—Mining Practice at Harmony Mines Co., Baker, Idaho. By R. Duncan Gardner.

6241—Concentrator Methods and Costs at the Hayden Plant of the Nevada Consolidated Copper Co., Arizona. By W. I. Garms.

(Includes flow sheets, description of concentrator methods, and account of method of dewartering concentrates, disposing of tailings, and moving ore through plant.)

6242—Safety in Utah Coal Mining as Affected by Haulage. By D. J. Parker.

6243—Safety in Connection with Haulage Practices in Alabama Coal Mines. By F. E. Cash.

6244—Practical Application and Cost of Proper Rock Dusting. By G. M. Kintz.

6245—Effect of Abnormal Air Conditions on Mine Workers. By R. R. Sayers.

6246—Data on Metal-Mine Ventilation in 1929. By D. Harrington.

(Discusses conditions brought to light during the year concerning factors in metal-mine ventilation. Deals with occurrence of gases; effect of blasting on air; fires, their causes and the methods of preventing and handling them; air conditioning; health as affected by ventilation; and up-to-date methods of forwarding and controlling air flow.)

6247—Mining Methods, Practices, and Costs of the Cananea Consolidated Copper Co., Sonora, Mexico. By William Catron.

6248—Methods and Costs of Stripping and Mining at the United Verde Open-Pit Mine, Jerome, Arizona. By E. M. J. Alenius.

6249—World Reserves and Resources of Tin. By Charles White Merrill.

6250—Mining Practice and Methods at the United Verde Extension Mining Company, Jerome, Arizona. By Richard L. D'Arcy.

6251—Mining Laws of Argentina. By A. D. Garman.

6253—Geophysical Abstracts No. 10. By F. W. Lee.

6254—The methods of Underground Mining of Iron Ore in the District of Krivoy Rog. Translated by W. Ayvazoglou from the Original Russian of A. K. Bouldovsky.

6255—Sillimanite, Kyanite, Andalusite, and Dumortierite. By Alice V. Petar.

6256—Phosphate Rock. Part I. General Information. By Bertrand L. Johnson.

6262—Proposed Standard Smoke Ordinance.

6273—Geophysical Abstracts No. 11. By Frederick W. Lee.

Petroleum Field Office:

Petroleum Refineries, Cracking Plants and Natural Gasoline Plants on the Pacific Coast. By E. T. Knudsen.

Recent Articles on Petroleum and Allied Substances:

October, 1928.
November, 1928.
December, 1929.
January, 1930.
February, 1930.

U. S. Department of Commerce:

National Bureau of Standards:

Standards Yearbook, 1930.

U. S. Bureau of Foreign and Domestic Commerce:

Monthly Summaries of Foreign Commerce of the United States.

Part 1, December, 1929.
Part 2, December, 1929.
Part 1, January, 1930.
Part 2, January, 1930.
Part 2, February, 1930.

Alabama Geological Survey:

Bulletin 35—Molding Sands of Alabama. By G. I. Adams.
Bulletin 37—Statistics of the Mineral Production of Alabama for 1927. By J. Barksdale.
Circular 7—The Bauxite Deposits of Alabama. By W. B. Jones.

California Fish and Game:

Volume 16, No. 1, January, 1930.

California State Department of Industrial Relations:

Labor Laws of the State of California, 1929.

California State Department of Public Works:

California Highways and Public Works.

California State Library:

Vol. 25, No. 1, 1930.

Idaho Bureau of Mines and Geology:

No. 12—Geology and Ore Deposits of the Clark Fork District, Idaho. By A. L. Anderson.
No. 33—Geology and Ore Deposits of the Seafoam, Alder Creek, Little Smoky, and Willow Creek Mining Districts, Custer and Camas Counties, Idaho. By C. P. Ross.

Iowa Geological Survey:

Vol. 33—Annual Report, 1927 with an Accompanying Paper on Deep Wells of Iowa.
Vol. 34—Annual Report, 1928, with Accompanying Papers.

Missouri Bureau of Geology and Mines:

Insoluble Residues as a Guide in Stratigraphic Studies. By H. S. McQueen.

Montana State Bureau of Mines and Metallurgy:

Bulletin No. 1—Bureau's Establishment.
2—Directory Montana Metal and Coal Mines.
3—Mechanical Ore Sampling in Montana. By H. B. Pulsifer.
4—Geology and Oil and Gas Prospects of Central and Eastern Montana.

Oklahoma Geological Survey:

Bulletin 48—Sedimentation in the Anadarka Basin. By A. J. Freie.
49—Dolomites of Western Oklahoma. By G. C. Suffel.
Circular No. 21—Foraminifera from the Atoka Formation of Oklahoma. By J. J. Galloway and C. Ryniker.

South Dakota Geological and Natural History Survey:

R. 1. No. 1—Mineral Producers in 1929.

Wisconsin Geological and Natural History Survey:

Bulletin 46—Mineral Lands of Part of Northern Wisconsin. By Hotchkiss, Bean and Aldrich.
Bulletin 71—The Geology of the Geogebic Iron Range of Wisconsin. By H. R. Aldrich.

Argentina Direccion de Minas, Geologia e Hidrologia:

Publicationes Nos. 34, 41, 44, 46, 56 y 67 hasta 78.

British Columbia Department of Mines:

Bulletin No. 2, 1930—Placer Mining in British Columbia.

Canada Department of Mines:

Bulletin 62—Annual Report for 1928.
Memoir 155—Horton-Windsor District, Nova Scotia. By W. A. Bell.
No. 701—Mica. By H. S. Spence.
No. 2217—Report for Fiscal Year Ending March 31, 1929.

Secretaria de Indústria, Comercio y Trabajo, Mexico.
Vol. 28, Nos. 1, 3, 4, 5, 6.
Vol. 29, No. 1.
Annuario de Estadistica Minera. Ano de 1927.

Nova Scotia Department of Public Works and Mines:
Annual Report on the Mines, 1929.

Ontario Department of Mines:
Vol. 37, Parts 1, 2, 3, 4, 5, 6, maps of Part 2.
Vol. 38, Part 2.
Vol. 38, Part 4.
Bulletin 72—Mineral Production of Ontario in 1929.

Quebec Bureau of Mines:
Preliminary Statement of the Mineral Production during 1929.

Scotland Geological Survey:
22—The Geology of North Ayrshire.

Transvaal Chamber of Mines:
Reports for the Year 1929.

Victoria Geological Survey:
No. 52—The Metamorphic Rocks of North-East Victoria. By C. M. Tattam.
Summary of Annual Reports and Records of Boring Operations for the Years 1919–1922.

Bulletins du Comite Geologique, Russia:
Vol. 48, Nos. 7, 8, 9, 10.
Livraison 90, 96, 100, 125, 127, 145, 149, 140, 143, 153.

Societies and Educational Institutions.

Academy of Natural Sciences of Philadelphia:
Vol. 81, 1929.

American Association of Petroleum Geologists:
Vol. 14, No. 2, February, 1930.
Vol. 14, No. 3, March, 1930.
Vol. 14, No. 4, April, 1930.

American Geographical Society:
Vol. 19, 1929.
Vol. 20, No. 2, 1930.

American Institute of Mining and Metallurgical Engineers, Inc.:
Unit Operation in California. By J. Jensen.
Unitized Operations Oklahoma and Kansas. By A. W. Ambrose and C. E. Beecher.

American Philosophical Society:
Vol. 68, No. 4, 1929.
Vol. 69, No. 1, 1930.
Vol. 69, No. 2, 1930.
Vol. 69, No. 3, 1930.

Australian Museum:
Vol. 16, No. 8.
Vol. 17, No. 6.

Brazil Museu Nacional:
Vol. XXX, 1928.
Catalogo da Mappotheca do Ministerio das Relacoes Exteriores, 1929.

Bulgarie Geologique Societe:
Vol. 2, Part 1, 1930.

Bulletin de la Societe Polonaise des Naturalistes "Kopernik":
Vol. 53, Fasc 4, VI (2)—Geologja i Mineralogja.

Canadian Institute of Mining & Metallurgy:
No. 214, February, 1930.
215, March, 1930.
216, April, 1930.

Colorado College:
General Series No. 164.

Colorado Scientific Society:
Vol. 12, No. 4—Geologic History of the Front Range, Colorado.

Economic Geology:
Vol. 25, No. 1, January-February, 1930.
Vol. 25, No. 2, March-April, 1930.

Engineer's Society of Western Pennsylvania.
Vol. 45, No. 9, December, 1929.
Vol. 46, No. 2, February, 1930.

Far Eastern University:
Serie 4, No. 6.
Serie 6, No. 8.
Serie 7, No. 12.
Serie 7, No. 13.
Serie 13, No. 9.

Great Britain Geological Survey:
217—The Country Around Moreton in Marsh.

Imperial University of Tokyo, Japan:
Vol. 2, Part 9, Section 2.
Vol. 3, Part 1, Section 1.

Institution of Mining and Metallurgy:
No. 304, January, 1930.
No. 305, February, 1930.
No. 306, March, 1930.
No. 307, April, 1930.

Library of Congress:
Vol. 20, No. 10.
Vol. 20, No. 11.
Vol. 20, No. 12.

Mineralogical Society of America:
Vol. 15, No. 2, February, 1930.
Vol. 15, No. 3, March, 1930.

Mining and Metallurgical Society of America:
Bulletin No. 208.
Bulletin No. 209.

Missouri School of Mines and Metallurgy:
Technical Series, Vol. II, No. 1—The Scientific Fundamentals of Gravity Concentrations. By J. Finkey.

Nevada University:
Vol. 19, No. 6—Comparative Properties of Lubricating Oil Made from Elko Nevada, Oil Shale. By F. H. Sibley.
Vol 23, No. 6—Tables of Elastic Properties of Alloys. By C. H. Kent.

Pennsylvania State College:
Technical Bulletin No. 8—Oil Power Conference.

Ryojun College of Engineering:
Publication No. 1.
Memoirs—Vol. II, No. 4—C and D.

Tohoku Imperial University:
Vol. 3, No. 3, 3d series.

Philippine Journal of Science:
Vol. 41, No. 2, February, 1930.
Vol. 41, No. 3, March, 1930.
Vol. 41, No. 4, April, 1930.

Physical Science Chronicle, Germany:
Band 76, Heft 1—3, 4—5, 6—7, 8—12.

Stanford University:
Abstracts of Dissertations, Volumes I, II, III, IV.
A Study of the Normal Constituents of the Potable Water of the San Francisco Peninsula. By J. P. Mitchell.
A Study of the Magmatic Sulfid Ores. By C. F. Tolman, Jr. and A. F. Rogers.
The Fish Fauna of the California Tertiary. By D. S. Jordan. Vols. I and II—The Marine Shells of the West Coast of North America. By I. S. Oldroyd.

University of Montana:
Bulletin 1—Neocene Lake Beds of Western Montana. By E. Douglass.
17—Some Volcanic Ash Beds of Montana. By J. P. Rowe.
37—Montana Coal and Lignite Deposits. By J. P. Rowe.
50—Some Economic Geology of Montana. By J. P. Rowe.

U. S. National Museum:
Smithsonian Institution:
Bulletin 149—Composition and Structure of Meteorites.

San Diego Society of Natural History:
Vol. 5, No. 19—A New Pacific Race of Gull-billed Tern. By G. Bancroft.
Vol. 5, No. 20—Fossil Diatoms Dredged from Bering Sea. By G. D. Hanna.
Vol. 6, No. 1—An Annotated List of the Butterflies of San Diego County, California. By W. S. Wright.
Vol. 6, No. 2—Tertiary Foraminifera from Humboldt County, California. By J. A. Cushman.
Vol. 6, No. 3—New and Renamed Subspecies of Crotalus Confluentus Say, with Remarks on Related Species. By L. M. Klauber.

Western Society of Engineers:
Vol. 35, No. 1, February, 1930.
Vol. 35, No. 2, April, 1930.

Books.

Asbestos. Compiled by W. B. Gamble, N. Y. Public Library.
Diatomaceous Earth. By Roberrt Calvert.
Hetch Hetchy. By R. W. Taylor.

Maps.

U. S. Geological Survey:
Topographic Maps:
Arizona:
Aztec Quadrangle.

California:
Buttonwillow Quadrangle, Kern County.
Delano Quadrangle.
East Elk Hills, Kern County.
Hacienda Ranch Quadrangle.
Famosa Quadrangle, Kern County.
Mouth of Kern Quadrangle, Kern County.
Porterville Quadrangle, Tulare County.
Quincy School Quadrangle.
Richgrove Quadrangle.

Rio Bravo Quadrangle.
Sausalito School Quadrangle, Tulare County.
Stone Quadrangle.
Stratford Quadrangle, Kings County.
West Alpaugh Quadrangle.

Colorado:

Grand Valley Quadrangle.

Idaho:

Casto Quadrangle.

Nevada:

Roberts Mountains Quadrangle.

North Dakota:

Coleharbor Quadrangle.
Kongsberg Quadrangle.

Oregon:

Mill City Quadrangle.

Texas:

Hunter Quadrangle.
Marble Falls Quadrangle.
Farmersville Quadrangle.
Frisco Quadrangle.
Boyd Quadrangle.
Simmons Quadrangle.
Luling Quadrangle.
McKinney Quadrangle.

Washington-Oregon:

Hood River Quadrangle.

Wisconsin-Minnesota:

La Crescent Quadrangle.

Current Magazines on File.

For the convenience of persons wishing to consult the technical magazines in the reading room, a list of those on file is appended:

Architect and Engineer, San Francisco.
Asbestos, Philadelphia, Pennsylvania.
Asbestology, Canadian Asbestos Co., Montreal, Canada.
Bessemer Monthly, Grove City, Pennsylvania.
Brick and Clay Record, Chicago.
California Safety News, San Francisco.
Caterpillar, San Leandro, California.
Chemical Engineering and Mining Review, Melbourne, Australia.
Chemical & Metallurgical Engineering, New York City.
Commerce Reports, Washington, D. C.
Colorado School of Mines, Golden, Colorado.
Engineering and Mining Journal, New York City.
Explosive Service Bulletins, Washington, Delaware.
Fuel Oil, Chicago, Illinois.
Fusion Facts, Whittier, California.
Graphite, Jersey City.
Grizzly Bear, Los Angeles.
Hercules Mixer, Wilmington, Delaware.
Industrial Employment Information Bulletin, Washington, D. C.
Lubrication, The Texas Co., New York City.
Mining Congress Journal, Washington, D. C.
Mining and Industrial Record, Vancouver, B. C.
Mining Journal, Phoenix, Arizona.
Mining and Metallurgy, New York City.

Mining Review, Salt Lake City.
Mining Truth, Spokane, Washington.
Mining Journal, London.
Monthly Review of Business Conditions, San Francisco.
National Sand and Gravel, Washington, D. C.
Oil Bulletin, Los Angeles.
Oil Field Engineering, Philadelphia, Pennsylvania.
Oil and Gas Journal, Tulsa, Oklahoma.
Oil, Paint and Drug Reporter, New York City.
Oil Trade, New York City.
Oil Weekly, Houston, Texas.
Pit and Quarry, Chicago.
Pacific Purchaser, San Francisco.
Petroleum Times, London, E. C. 2.
Petroleum Age, Chicago.
Petroleum World and Oil Age, Los Angeles.
Queensland Government Mining Journal, Brisbane, Australia.
Record, Associated Oil Co., San Francisco.
Rocks and Minerals, Peekskill, New York.
Rock Products, Chicago.
Scientific American, New York City.
Southwest Builder and Contractor, Los Angeles.
Standard Oil Bulletin, San Francisco.
Stone, New York City.
Through the Ages, Baltimore.

Newspapers.

The following papers are received and kept on file in the library:

Amador Dispatch, Jackson, California.
Barstow Printer, Barstow, California.
Beaumont Gazette, Beaumont, California.
Bridgeport Chronicle-Union, Bridgeport, California.
California Oil World, Los Angeles, California.
Colusa Daily Sun, Colusa, California.
Daily Commercial News, San Francisco, California.
Daily Midway Driller, Taft, California.
Del Norte Triplicate, Crescent City, California.
Denver Mining Record, Denver, Colorado.
Exeter Sun, Exeter, California.
Goldfield News, Goldfield, Nevada.
Inyo Independent, Independence, California.
Inyo Register, Bishop, California.
Ione Valley Echo, Ione, California.
Mariposa Gazette, Mariposa, California.
Mercury Register, Oroville, California.
Mojave Miner, Kingman, Arizona.
Morning Union, Grass Valley, California.
Mountain Messenger, Downieville, California.
Nevada City Nugget, Nevada City, California.
Nevada Mining Press, Reno, Nevada.
Oil Refinery News, Bayonne, New Jersey.
Petroleum Press, Taft, California.
Placer Herald, Auburn, California.
Plumas Independent, Quincy, California.
San Diego News, San Diego, California.
Shasta Courier, Redding, California.
Siskiyou News, Yreka, California.
Sotoyome Scimitar, Healdsburg, California.
Stockton Record, Stockton, California.
Tuolumne Prospector, Tuolumne, California.
Ventura County News, Ventura, California.
Waterford News, Waterford, California.
Weekly Trinity Journal, Weaverville, California.
Western Sentinel, Etna Mills, California.

PRODUCERS AND CONSUMERS

The producer and consumer of mineral products are mutually dependent upon each other for their prosperity, and one of the most direct aids rendered by the Bureau to the mining industry in the past has been that of bringing producers and consumers into direct touch with each other.

This work has been carried on largely by correspondence, supplemented by personal consultation. Lists of buyers of all the commercial minerals produced in California have been made available to producers upon request, and likewise the owners of undeveloped deposits of various minerals, and producers of them, have been made known to those looking for raw mineral products.

When the publication of MINING IN CALIFORNIA was on a monthly basis, current inquiries from buyers and sellers were summarized and lists of mineral products or deposits 'wanted' or 'for sale' included in each issue.

It is important that inquiries of this nature reach the mining public as soon as possible and in order to avoid the delay incident to the present quarterly publication of MINING IN CALIFORNIA, these lists are now issued monthly in the form of a mimeographed sheet under the title of 'Commercial Mineral Notes,' and sent to those on the mailing list for MINING IN CALIFORNIA.

EMPLOYMENT SERVICE

Following the establishment of the Mining Division branch offices in 1919, a free technical employment service was offered as a mutual aid to mine operators and technical men for the general benefit of the mineral industry.

Briefly summarized, men desiring positions are registered, the cards containing an outline of the applicant's qualifications, position wanted, salary desired, etc., and as notices of 'positions open' are received, the names and addresses of all applicants deemed qualified are sent to the prospective employer for direct negotiations.

Telephone and telegraphic communications are also given immediate attention.

Technical men, or those qualified for supervisory positions, and vacancies of like nature only, are registered, as no attempt will be made to supply common mine and mill labor.

Registration cards for the use of both prospective employers and employees may be obtained upon request, and a cordial invitation is extended to the industry to make free use of the facilities afforded. Parties interested should communicate direct with our San Francisco office.

PUBLICATIONS OF THE DIVISION OF MINES

During the past fifty years, in carrying out the provisions of the organic act creating the former California State Mining Bureau, there have been published many reports, bulletins and maps which go to make up a library of detailed information on the mineral industry of the state, a large part of which could not be duplicated from any other source.

One feature that has added to the popularity of the publications is that many of them have been distributed without cost to the public, and even the more elaborate ones have been sold at a price which barely covers the cost of printing.

Owing to the fact that funds for the advancing of the work of this department have often been limited, many of the reports and bulletins mentioned were printed in limited editions which are now entirely exhausted.

Copies of such publications are available, however, in the office of the Division of Mines, in the Ferry Building, San Francisco; New Orpheum Building, Los Angeles; State Office Building, Sacramento; Redding; Santa Maria; Santa Paula; Coalinga; Taft; Bakersfield. They may also be found in many public, private and technical libraries in California and other states, and foreign countries.

A catalog of all publications from 1880 to 1917, giving a synopsis of their contents, is issued as Bulletin No. 77.

Publications in stock may be obtained by addressing any of the above offices and enclosing the requisite amount in the case of publications that have a list price. Only coin, stamps or money orders should be sent, and it will be appreciated if remittance is made in this manner rather than by personal check.

The prices noted include delivery charges to all parts of the United States. Money orders should be made payable to the Division of Mines.

NOTE.—The Division of Mines frequently receives requests for some of the early reports and bulletins now out of print, and it will be appreciated if parties having such publications and wishing to dispose of them will advise this office.

REPORTS

Asterisks (**) indicate the publication is out of print.

	Price
**First Annual Report of the State Mineralogist, 1880, 43 pp. Henry G. Hanks	----
**Second Annual Report of the State Mineralogist, 1882, 514 pp., 4 illustrations, 1 map. Henry G. Hanks	----
**Third Annual Report of the State Mineralogist, 1883, 111 pp., 21 illustrations. Henry G. Hanks	----
**Fourth Annual Report of the State Mineralogist, 1884, 410 pp., 7 illustrations. Henry G. Hanks	----
**Fifth Annual Report of the State Mineralogist, 1885, 234 pp., 15 illustrations, 1 geological map. Henry G. Hanks	----
**Sixth Annual Report of the State Mineralogist, Part I, 1886, 145 pp., 3 illustrations, 1 map. Henry G. Hanks	----
**Part II, 1887, 222 pp., 36 illustrations. William Irelan, Jr.	----
**Seventh Annual Report of the State Mineralogist, 1887, 315 pp. William Irelan, Jr.	----
**Eighth Annual Report of the State Mineralogist, 1888, 948 pp., 122 illustrations. William Irelan, Jr.	----

REPORTS—Continued

Asterisks (**) indicate the publication is out of print.

	Price
**Ninth Annual Report of the State Mineralogist, 1889, 352 pp., 57 illustrations, 2 maps. William Irelan, Jr.	----
**Tenth Annual Report of the State Mineralogist, 1890, 983 pp., 179 illustrations, 10 maps. William Irelan, Jr.	----
Eleventh Report (First Biennial) of the State Mineralogist, for the two years ending September 15, 1892, 612 pp., 73 illustrations, 4 maps. William Irelan, Jr.	$1.00
**Twelfth Report (Second Biennial) of the State Mineralogist, for the two years ending September 15, 1894, 541 pp., 101 illustrations, 5 maps. J. J. Crawford	----
**Thirteenth Report (Third Biennial) of the State Mineralogist, for the two years ending September 15, 1896, 726 pp., 93 illustrations, 1 map. J. J. Crawford	----
Chapters of the State Mineralogist's Report, Biennial Period, 1913–1914, Fletcher Hamilton:	
**Mines and Mineral Resources, Amador, Calaveras and Tuolumne Counties, 172 pp., paper	----
Mines and Mineral Resources, Colusa, Glenn, Lake, Marin, Napa, Solano, Sonoma and Yolo Counties, 208 pp., paper	.50
**Mines and Mineral Resources, Del Norte, Humboldt and Mendocino Counties, 59 pp., paper	----
**Mines and Mineral Resources, Fresno, Kern, Kings, Madera, Mariposa, Merced, San Joaquin and Stanislaus Counties, 220 pages, paper	----
**Mines and Mineral Resources of Imperial and San Diego Counties, 113 pp., paper	----
**Mines and Mineral Resources, Shasta, Siskiyou and Trinity Counties, 180 pp., paper	----
**Fourteenth Report of the State Mineralogist, for the Biennial Period 1913–1914, Fletcher Hamilton, 1915:	
A General Report on the Mines and Mineral Resources of Amador, Calaveras, Tuolumne, Colusa, Glenn, Lake, Marin, Napa, Solano, Sonoma, Yolo, Del Norte, Humboldt, Mendocino, Fresno, Kern, Kings, Madera, Mariposa, Merced, San Joaquin, Stanislaus, San Diego, Imperial, Shasta, Siskiyou and Trinity Counties, 974 pp., 275 illustrations, cloth	----
Chapters of the State Mineralogist's Report, Biennial Period, 1915–1916. Fletcher Hamilton:	
**Mines and Mineral Resources, Alpine, Inyo and Mono Counties, 176 pp., paper	----
Mines and Mineral Resources, Butte, Lassen, Modoc, Sutter and Tehama Counties, 91 pp., paper	.50
Mines and Mineral Resources, El Dorado, Placer, Sacramento and Yuba Counties, 198 pp., paper	.65
Mines and Mineral Resources, Monterey, San Benito, San Luis Obispo, Santa Barbara and Ventura Counties, 183 pp., paper	.65
**Mines and Mineral Resources, Los Angeles, Orange and Riverside Counties, 136 pp., paper	----
**Mines and Mineral Resources, San Bernardino and Tulare Counties, 186 pp., paper	----
**Fifteenth Report of the State Mineralogist, for the Biennial Period 1915–1916, Fletcher Hamilton, 1917:	
A General Report on the Mines and Mineral Resources of Alpine, Inyo, Mono, Butte, Lassen, Modoc, Sutter, Tehama, Placer, Sacramento, Yuba, Los Angeles, Orange, Riverside, San Benito, San Luis Obispo, Santa Barbara, Ventura, San Bernardino and Tulare Counties, 990 pp., 413 illustrations, cloth	----
Chapters of the State Mineralogist's Report, Biennial Period 1917–1918, Fletcher Hamilton:	
Mines and Mineral Resources of Nevada County, 270 pp., paper	.75
Mines and Mineral Resources of Plumas County, 188 pp., paper	.50
Mines and Mineral Resources of Sierra County, 144 pp., paper	.50
Seventeenth Report of the State Mineralogist, 1920, 'Mining in California during 1920,' Fletcher Hamilton; 562 pp., 71 illustrations, cloth	1.75
Eighteenth Report of the State Mineralogist, 1922, 'Mining in California,' Fletcher Hamilton. Chapters published monthly beginning with January, 1922:	
**January, **February, **March, **April, **May, **June, July, August, **September, October, November, December, 1922	Free
Chapters of Nineteenth Report of the State Mineralogist, 'Mining in California,' Fletcher Hamilton and Lloyd L. Root. January, February, March, September, 1923	Free
Chapters of Twentieth Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly. January, April, **July, October, 1924, per copy	.25

REPORTS—Continued

Asterisks (**) indicate the publication is out of print.

	Price
Chapters of Twenty-first Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly:	
January, 1925, Mines and Mineral Resources of Sacramento, Monterey and Orange Counties	$0.25
April, 1925, Mines and Mineral Resources of Calaveras, Merced, San Joaquin, Stanislaus and Ventura Counties	.25
July, 1925, Mines and Mineral Resources of Del Norte, Humboldt and San Diego Counties	.25
October, 1925, Mines and Mineral Resources of Siskiyou, San Luis Obispo and Santa Barbara Counties	.25
Subscription, $1.00 in advance (by calendar year, only).	
Chapters of Twenty-second Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly:	
January, 1926, Mines and Mineral Resources of Trinity and Santa Cruz Counties	.25
April, 1926, Mines and Mineral Resources of Shasta, San Benito and Imperial Counties	.25
July, 1926, Mines and Mineral Resources of Marin and Sonoma Counties	.25
October, 1926, Mines and Mineral Resources of El Dorado and Inyo Counties, also report on Minaret District, Madera County	.25
Chapters of Twenty-third Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly:	
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**Map of Forest Reserves in California	----
**Mineral and Relief Map of California	----
**Map of El Dorado County, Showing Boundaries, National Forests	----
**Map of Madera County, Showing Boundaries, National Forests	----
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DIVISION OF MINES

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Walter W. Bradley,
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Mining in California

JULY, 1930

PUBLISHED QUARTERLY

STATE OF CALIFORNIA
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF MINES

FERRY BUILDING
SAN FRANCISCO

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STATE OF CALIFORNIA
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DIVISION OF MINES
FERRY BUILDING, SAN FRANCISCO

WALTER W. BRADLEY — State Mineralogist

Vol. 26 — JULY, 1930 — No. 3

CHAPTER OF

REPORT XXVI OF THE STATE MINERALOGIST

COVERING

ACTIVITIES OF THE DIVISION OF MINES

INCLUDING THE

GEOLOGIC BRANCH

CALIFORNIA STATE PRINTING OFFICE
SACRAMENTO, 1930

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PREFACE

The Division of Mines (formerly State Mining Bureau) is maintained for the purpose of assisting in all possible ways in the development of California's mineral resources.

As one means of offering tangible service to the mining public, the State Mineralogist for many years has issued an annual or a biennial report reviewing in detail the mines and mineral deposits of the various counties.

The weak point in work of this character has been that the results of field investigations were so long in preparation that they had lost much of their usefulness by the time they finally appeared in print.

As a progressive step in advancing the interests of the mineral industry, publication of the Annual Report of the State Mineralogist in the form of monthly chapters was begun in January, 1922, and continued until March, 1923.

Owing to a lack of funds for printing this was changed to quarterly publication, beginning in September, 1923.

For the same reason, beginning with the January, 1924, issue, it has been necessary to charge a subscription price of $1 per calendar year, payable in advance; single copies, 25 cents apiece. 'Mining in California' will continue to be sent without charge to our exchange list, including schools and public libraries, as are also other publications of the Division of Mines.

Pages are numbered consecutively throughout the year and an index to the complete reports is included annually in the closing number.

Such a publication admits of several improvements over the old method of procedure. Each issue contains a report of the current development and mining activities of the state, prepared by the district mining engineers. Special articles dealing with various phases of mining and allied subjects by members of the staff and other contributors are included. Mineral production reports formerly issued only as an annual statistical bulletin are published herein as soon as returns from producers are compiled. The executive activities, and those of the laboratory, museum, library, employment service and other features with which the public has had too little acquaintance also are reported.

While current activities of all descriptions will be covered in these chapters, the practice of issuing from time to time technical reports on special subjects will be continued, as well. A list of such reports now available is appended hereto, and the names of new bulletins will be added in the future as they are completed.

The chapters will be subject to revision, correction and improvement. Constructive suggestions from the mining public will be gladly received, and are invited.

The one aim of the Division of Mines is to increase its usefulness and to stimulate the intelligent development of the wonderful, latent resources of the State of California.

State of California
DIVISION OF MINES
WALTER W. BRADLEY
STATE MINERALOGIST
OUTLINE MAP
OF
CALIFORNIA
SCALE
OREGON
NEVADA
PACIFIC OCEAN
MEXICO
SISKIYOU
MODOC
TRINITY
SHASTA
LASSEN
HUMBOLDT
TEHAMA
PLUMAS
GLENN
BUTTE
SIERRA
MENDOCINO
COLUSA
YUBA
NEVADA
PLACER
LAKE
EL DORADO
YOLO
SONOMA
NAPA
AMADOR
ALPINE
SOLANO
MARIN
CONTRA COSTA
SAN JOAQUIN
TUOLUMNE
MONO
SAN FRANCISCO
ALAMEDA
STANISLAUS
MARIPOSA
SANTA CLARA
MERCED
MADERA
FRESNO
INYO
SAN BENITO
MONTEREY
TULARE
KINGS
SAN LUIS OBISPO
KERN
SAN BERNARDINO
SANTA BARBARA
VENTURA
LOS ANGELES
ORANGE
RIVERSIDE
SAN DIEGO
IMPERIAL
LEGEND
Mining Division Boundaries.
Mining Division Offices.

DISTRICT REPORTS OF MINING ENGINEERS

In 1919–1920 the Mining Bureau was organized into four main geographical divisions, with the field work delegated to a mining engineer in each district, working out from field offices that were established in Redding, Auburn, San Francisco and Los Angeles, respectively. This move brought the office into closer personal contact with operators, and it has many advantages over former methods of conducting field work. In 1923 the Redding and Auburn field offices were consolidated and moved to Sacramento.

The Redding office was reestablished in 1928, and the boundaries of each district adjusted. The counties now included in each of the four divisions, and the locations of the branch offices, are shown on the accompanying outline map of the state. (Frontispiece.)

Reports of mining activities and development in each division, prepared by the district engineer, will continue to appear under the proper field division heading.

Although the petroleum industry is but little affiliated with other branches of mining, oil and gas are among the most valuable mineral products of California, and a report by the State Oil and Gas Supervisor on the current development and general conditions in the state's oil fields is included under this heading.

New County Reports.

The series of separate reports on the mines and mineral resources of the different counties, that together comprise the State Mineralogist's Reports XIV to XVII, inclusive, in the case of many of the counties have become exhausted. Those still in stock being in need of revision, it was deemed advisable, beginning with the January, 1925, issue of 'Mining in California,' to make the district engineers' reports in the form of a complete general report on the mines and mineral resources in one or more of the counties in each district.

This program has been followed as nearly as possible in succeeding numbers of the quarterly.

REDDING FIELD DIVISION

CHAS. VOLNEY AVERILL, Mining Engineer

There is no report from the Redding Field Division, as the present series of county reports is complete for that district, and Mr. Chas. V. Averill, District Mining Engineer, is engaged on geological field studies in the Shasta Quadrangle.

SACRAMENTO FIELD DIVISION

C. A. Logan, Mining Engineer

YUBA COUNTY

Geography.

Of irregular shape, having a length of 45 miles from northeast to southwest and an area of 639 square miles, Yuba County extends from the Sacramento Valley to an elevation of 3500 feet, sharing the physical and geologic characteristics of the neighboring counties of Butte, Placer and Nevada. Marysville, the county seat, is 50 miles by paved highway from Sacramento, and the valley portion of the county is served by three railroads. The westerly third of the county is flat valley land, breaking into rolling foothills near Browns Valley, these in turn passing into the lower mountain slopes. Yuba River and Honcut Creek, flowing southwest into Feather River, drain the county. Good timber is found in abundance above the 2000-ft. contour. Farming, and particularly fruit-raising, is the principal industry in the valley and the summer ranging of cattle and the cutting of some lumber are the principal activities of the mountain section. A number of small hamlets are scattered along the roads extending from Marysville and Oroville, which join at Challenge, thence climbing the mountains to La Porte and Quincy in Plumas County. The few mining districts are served by good dirt roads.

Although electric power is generated on a large scale at Bullards Bar, it is not generally available to the scattered small mines. The quartz prospects usually develop enough water from their own workings for milling.

Mineral Resources and Geology.

Because of the rich dredging field surrounding Hammonton and Marigold on Yuba River 12 miles east of Marysville, Yuba County has long been one of the leading gold-producing counties of the state. Sand dredged from Yuba River is next in importance. Silver, which occurs alloyed with gold (but is not mined separately), and metals of the platinum group, which are a by-product of gold dredging, are next in value. In years past there has been small and irregular production of brick, pottery clay, mineral water, copper and natural gas. None of these is being worked now. Asbestos and soapstone prospects occur, but have appeared either too small or too remote to merit development.

The valley portion of the county to within a mile of the town of Browns Valley, is covered by sand and gravel, with a mantle of fertile soil in the region contiguous to the rivers. The dredging fields lie on the Yuba River and its adjacent flood plain for several miles in length, beginning where the stream breaks from its rocky canyon near Parks Bar bridge, spreading over the 'false bedrock' of volcanic ash which lies under the gravel and which forms the bottom for dredging work.

The foothill region beginning near Browns Valley is entirely of greenstones classified as diabase, porphyrite and 'amphibolite schist' for 9 to 11 miles northeastward, and such rocks evidently mantled the region once nearly to the easterly county line. Erosion of the higher

MINERAL PRODUCTION OF YUBA COUNTY, 1880-1928

Year	Gold, value	Silver, value	Platinum		Miscellaneous stone,[1] value	Miscellaneous and unapportioned		
			Ounces	Value		Amount	Value	Substance
1880	$943,860	$438						
1881	800,000	1,300						
1882	750,000							
1883	455,000							
1884	250,000							
1885	207,449							
1886	149,203							
1887	162,426							
1888	150,000							
1889	112,053	115						
1890	141,781							
1891	37,576							
1892	44,218							
1893	30,839							
1894	107,480							
1895	111,482							
1896	171,688							
1897	141,638							
1898	166,865							
1899	189,927	12						
1900	280,366	[2]2,041						
1901	188,908	[2]393						
1902	155,630	2						
1903	125,830	41						
1904	139,528					400 M. 375 tons 400 tons	$3,000 750 80	Brick. Pottery clay. Pottery clay.
1905	324,135	369				2,000 gals.	800	Mineral water.
1906	[3]	[3]				2,000 gals.	800	Mineral water.
1907	1,766,770	6,167				1,800 gals.	720	Mineral water.
1908	2,034,486	9,997			$5,750	1,000 M.	10,000	Brick.
1909	2,469,865	4,156			5,650	550 M.	6,600	Brick.
							568,564	Unapportioned, 1900-1909.
1910	3,204,273	5,372						
1911	2,997,072	5,299			9,318			
1912	2,753,408	6,198			15,526			
1913	2,491,505	7,571			8,063			
1914	2,800,713	5,295	74	$2,377	14,895			
1915	2,703,710	5,254	132	4,174	149,292			
1916	3,167,723	5,934	314	14,301	42,685	4,817 lbs.	1,185	Copper.
							6,000	Other minerals.
1917	3,667,673	6,591	149	8,869	28,863			
1918	3,767,933	13,796	189	12,930	43,338		6,888	Other minerals.
1919	4,195,732	12,276	[4]125	13,098	40,439			
1920	3,467,769	16,502	113	14,395	74,943		40	Other minerals.
1921	4,738,248	26,135	179	14,396	73,387		100	Other minerals.
1922	2,492,948	8,222	115	11,077	75,969		100	Other minerals.
1923	3,150,405	6,760	158	16,974	216,890		100	Other minerals.
1924	1,995,434	4,461	73	8,773	181,113		100	Othre minerals.
1925	2,570,630	6,400	[3]		137,288		7,276	Natural gas, platinum.
1926	2,769,703	6,398	[3]		133,298		11,695	Natural gas, platinum.
1927	3,468,201	6,743			198,688		6,000	Other minerals.
1928	2,304,377	4,910	[3]		202,708		17,081	Other minerals.
1929	1,456,039	2,648	[3]		364,326		7,358	Other minerals.
Totals	$72,772,499	$187,796	1,621	$121,364	$2,022,429		$655,237	

[1] Includes crushed rock, sand, gravel.
[2] Recalculated to 'commercial' from 'coining value' as originally published.
[3] See under 'Unapportioned.'
[4] Includes some palladium.

hills has, however, revealed the upper surfaces of the granitic batholiths composed of gabbrodiorite and granodiorite, which originally intruded the overlying greenstones and cooled and crystallized under a great depth of these rocks, which have since been carried away. East of the greenstones and granitic rocks, in the northeastern corner of the county, there is a small area of the Calaveras (Carboniferous) rocks, principally hard slaty schist and quartzite with accompanying serpentine, succeeded on the east by amphibolite.

The most important quartz mines have been in the Browns Valley district, where an area of 'amphibolite schist' striking northwest indicates that the rock has been subjected to great pressure and to chemical action. The Too Handy vein, now being prospected, is in this 'amphibolite schist,' which here shows several distinctly different bands of rock, including a coarsely crystaline gabbro or diabase; a grey felsitic rock with flow structure and a black, schistose graphitic dike, probably of Calaveras rocks, caught up in the original diabase intrusive. An intrusive body of granodiorite has also been encountered here, about five miles from the nearest mapped outcrop. This area of amphibolite schist extends across the county to the southeast, but although other veins occur in it, none have so far proved valuable.

The veins at Dobbins are in gabbrodiorite. Those near Challenge are in 'amphibolite schist' and those near Hansonville lie in or near the contact of gabbrodiorite and diabase.

The Neocene Yuba River entered the county a mile east of Smartsville. From the section about 2½ miles long which had escaped erosion much gold was taken by hydraulicking. The eroded sections contributed to the richness of the dredging fields.

GOLD (QUARTZ MINES)

Gold quartz mining in Yuba County has been almost at a standstill during the past ten years. There is little to add to the reports previously published. Some work is being done near Browns Valley at the Too Handy Mine, near Dobbins at the Red Cross and near Challenge at the Mount de Oro, Beehive and other properties. The quartz prospects occur in the amphibolite and in the vicinity of the contacts of basic igneous intrusives of granitic texture with the amphibolite schists and similar greenstones. Quartz mining has never been of much importance in this county though there have been numerous surface showings which have yielded pockets and small tonnages of good ore. The various prospects and old mines were described in a chapter of the State Mineralogist's Fifteenth Report, which is still available for sale. The notes herewith cover only the work since that report was written.

The total recorded production of gold quartz ore in the county from 1914 to 1928, inclusive, was only 2500 tons which yielded less than $27,000. Besides those mentioned in detail, some ore and tailing was worked by the cyanide process at the *Henry George Mine* in 1925, and some work was done at the *Good Title Mine* in 1924. The *California Mother Lode Mine* in the same district was a producer in 1913 but has been idle and the subject of litigation since.

Beehive or *Mount Hope Mine* is two miles from Woodleaf on the Oroville-La Porte road in Sec. 8, T. 19 N., R. 7 E. Mount Hope Min-

ing Company, Thomas Snook, secretary and manager, Woodleaf, is engaged in reopening it. There are two claims and a millsite.

An old inclined shaft sunk at an angle of 35°, with levels at 50 and 100 feet deep, had been cleaned out and retimbered to a depth of 60 feet when visited July 10, and the drain adit and most of the 50-ft. level had been reclaimed. This level has a total length of 730 feet including the drain adit and 525 feet of drifting on the vein, which has been stoped from there to the surface for a reported length of 400 feet. The vein strikes north and dips 30° to 45° east, varying in width from two to 12 feet. On the 100-ft. level, work is said to have not yet reached the vein. Most of the work was done 35 or more years ago when the mine was equipped with an 8-stamp mill. The operators have no definite record of the tonnage or value of past output. Three men were employed and there was no new equipment on the claims when visited.

Bibl: State Mineralogist's Reports XII, p. 317; XIII, p. 501; XV, p. 444.

Easy Money Prospect is in the SW¼ of NW¼ Sec. 17, T. 19 N., R. 7 E., and contains 40 acres, patented. J. P. Bollinger in charge. It is two miles north of Challenge by road.

Formerly worked by Harvey, who made a production of a few thousand dollars, it was sold by him several years ago and the present stock company was formed. The old workings were cleaned out and a little new work has been done. There has been no production by the present company, and no ore has been proved.

A crosscut adit 505 feet long cuts a vein of bluish quartz eight inches wide. An ore shoot 20 feet long was stoped from here to the surface, a distance of only 50 feet on the dip, by former operators. From this place the adit was run south 320 feet to a shaft 93 feet deep; thence 35 feet south, and also from the shaft 28 feet west to prospect narrow seams. The one cut on the west was followed north and south 100 feet but widened to only three inches. No. 3 adit, 318 feet long and 72 feet deep at the face, is also on a narrow quartz seam. All the workings are in the upper, decomposed part of what was evidently diorite or a similar igneous rock, and the narrow seams and veinlets of quartz evidently occupy joints or shrinkage cracks.

There is a small home-made 6-stamp mill with 75-lb. stamps on the property. Second-hand automobile engines are used to run the mill and the hoist at the vertical shaft.

Horseshoe Mine is a mile and a half northeast of Challenge in SW¼ Sec. 21, T. 19 N., R. 7 E. Owners, Fred Clemons and Mrs. Clemons, Browns Valley, and Joseph Supple, Portland, Oregon. Recently a lease and option to purchase was given to I. O. Wallberg who formed the *Wallberg Mining Corporation.* This company tore down the five stamps which had been previously erected and started to install ten stamps but has lately become involved in financial troubles and at present (July 15) labor liens and other claims have been filed against the property and company and work has been stopped pending court action.

The vein, which pinches and swells but averages about 20 inches wide, strikes north and dips west between hard walls of schist. Many years ago it was prospected by a shaft 90 feet deep from which Clemons

states he took 23 tons of ore of such good grade as to justify further prospecting. In 1920–21 a crosscut adit was run 600 feet to the vein at a depth of 200 feet and a drift was run 220 feet north following the vein. A 5-stamp mill was erected and a connection made from the adit with the shaft, but only a few small lots of ore were milled before the mill burned down. The reported yield from some of this ore appears to justify further work.

The five stamps had been set up again after the fire, and would have been sufficient for milling, at least until a tonnage of ore large enough to justify more milling capacity had been definitely blocked out. Water sufficient for milling can be had only in winter and spring under present conditions.

Kingbird Mine is a mile northeast of Clipper Mills. Some work has been done on both the *Little Kingbird* and the *Big Ledge* or *Kingbird,* which are about a mile apart. The Little Kingbird vein, on which the last work was done in 1921 and 1922, strikes north and dips east, varying in width from one foot to nine feet but averaging three feet. A shaft was sunk upon it to a depth of 125 feet and a crosscut 350 feet to vein, with a drift 225 feet long on vein, connects with the shaft at a depth of about 100 feet. Between December, 1921, and March, 1922, about 700 tons of ore was milled in the 5-stamp mill. According to the foreman, Goeken, it averaged $7 a ton. No work has been done since.

On the Big Ledge, which is 20 feet wide, only a little shallow work was done years ago.

Mount de Oro Mine is in the S½ of SW¼ Sec. 9, T. 19 N., R. 7 E., one-half mile southwest of Woodleaf. It contains 80 acres patented and two unpatented mining claims. The owners are Wm. Beik, Challenge; Leslie Crouch, Chico, and Jos. Supple, Portland, Oregon. It is under lease and option to Mt. de Oro Gold Mining Company, a Nevada corporation. Riley W. Self, secretary. Allen G. Fraser and Collins are planning to take over the lease and option.

The prospect was worked in a small way ten years ago by Wm. Beik, Jos. Supple et al., at which time about 50 tons of ore was taken out and milled. Later a mill was built and 500 tons of ore is stated to have been milled and according to Beik yielded $8 a ton in free gold, with an equal amount lost in the tailing, as there were no concentrators in the mill, and the ore carries considerable sulphide of good grade. The present company made a mill run of 40 tons which confirmed the good grade of the ore and the high tailing loss, according to Self.

The vein, which strikes N. 15° W., is reached on the lowest level by a crosscut adit 650 feet long, with 40 feet of drifting on the vein. At this depth, the inner workings show comparatively fresh wall rock and vein matter, devoid of the leaching and oxidation noted higher. The wall rock is gabbrodiorite of rather coarse texture and the vein of bluish quartz thickly sprinkled with pyrite. In the upper workings, the vein has been leached and kaolinized; the action of air and surface water have oxidized the pyrite, forming from this an acid solution which has leached out the soluble ingredients of the vein and walls leaving a siliceous rock carrying free gold and a little iron oxide. The vein varies from two to five feet wide on the north but pinches to a width of a few inches in the southeast end of workings. The ore shoot

had been opened for a length of 90 feet on the 120-ft. level, which connects by a raise of 50 feet on dip, with the lowest adit, and with a shaft. Assays, pannings and mill tests all indicate that the ore shoot is good grade ore.

The mill, which is nearly new, contains five heavy stamps and a 25-h.p. semi-Diesel engine. A Wilfley concentrator has been added lately, but little else has been done the past year. The mine was idle in July, 1930, pending the proposed transfer to Fraser and Collins.

Red Cross Mine is in Sec. 29, T. 18 N., R. 7 E., one mile north of Dobbins at an elevation of 1950 feet. Red Cross Mining Company, 620½ I street, Sacramento, or Dobbins. Edward S. Van Dyck, president. The company is working on a tract of 160 acres upon which shallow mining was carried on by previous operators. A former company began prospecting in 1915 but went out of existence in three years. The present concern was incorporated in 1924 in Nevada and has been working in a small way since.

Two small flat veins, lying only 20 and 40 feet below the surface, were worked through adits until one of them steepened. It has been followed with an inclined shaft to a depth of 130 feet on the dip. It strikes N. 60° E. and dips 45° W. The width varies, being often less than one foot, but a width of three to four feet is mined on the hanging wall side which is also said to carry some gold. Both walls are soft, rotten gabbrodiorite and stopes have to be timbered with square sets and lagging. The country rock is soft and altered as deep as mining has gone. The 60-ft. level or drain level No. 2 is about 650 feet long connecting with the shaft. It is in the footwall of the flat vein, which, according to the company's assay record, gave assays of from $4 to $24 a ton for an average width of one foot. The 90-ft. level has been run 50 feet southwest and 137 feet northeast from the shaft. From this level up to the adit level on the northeast side of the shaft the vein has been stoped out and the level has caved. From the southwest end of this level an air raise run through the hanging wall to the surface is said to have shown a gold value of $1.44 a ton, every fourth bucket having been milled. This rock is altered so far that it is easily picked and shows rusty and kaolinized seams. The 130-ft. level, running 60 feet northeast and 85 feet southwest, yields about 40 g.p.m. of water, which is used partly for milling. Stoping is going on above this level. Other shallow workings include the No. 1 adit, running 200 feet northwest, and a number of shallow shafts and pits, said to indicate possibilities of a large, low-grade orebody. Ore is raised in a bucket of 500 lbs. capacity, operated by a 20-h.p. electric hoist.

The mill contains two stamps, which are said to handle 15 tons of the soft, decomposed wall rock making up most of the tonnage milled, in 24 hours. It is operated only 8 hours a day at present. After crushing to 20-mesh, ore passes to two Devereaux agitators, where it has 24 hours contact with cyanide solution; the solution then passes to clarifiers and zinc boxes. A recovery of 90% is claimed, of which 80% is by cyanide, no amalgamation plates being used. One-half pound of cyanide and five pounds of lime are used per ton of ore. Ore is reported to be of fair grade. Four men are employed.

Too Handy Mine is in SW¼ Sec. 22, T. 16 N., R. 5 E., on the north side of the Yuba Consolidated Gold Fields holdings about one mile

from Browns Valley. Hammon Engineering Company is doing the prospecting work for the owners. Thomas Hamlyn, superintendent.

Work was started by the company after gold bearing quartz had been dug from the river by one of the dredgers. The new shaft, through which all work is being done, is 1000 feet S. 30° E. from the old shaft. The present operators reclaimed the old shaft and did some prospecting there. The new shaft was then sunk 410 feet vertically. Unusually hard rock was encountered and this work was expensive. One level was turned at a depth of 350 feet and the vein has been followed about one-half mile in a southeasterly direction. The vein occurs in, or has for one wall, a narrow belt of graphitic, schistose dike material, lying in the series of greenstone rocks called 'amphibolite schist.' There is no true Mariposa clay slate here, but the graphitic dike material is probably Calaveras. The greenstone shows several variations, including coarse, granular gabbro or diabase and a green and grey felsitic rock with flow structure, both on the hanging wall side, with grey dike rock streaked by black on the footwall. The black and grey schist occur together in bands and streaks without any contact between. Granodiorite about 800 feet wide cuts across the mine workings, without much disturbance. The vein has been crushed in places by a post-mineral strike fault. It is of fair width so far as followed, but assays are reported to show it spotted and irregular in gold content. The sulphides (principally pyrite) are said to carry most of the pay.

Equipment includes hoist operated by 75-h.p. motor, centrifugal pump with 50-h.p. motor and air compressor. As the workings are under Yuba River, 350 g.p.m. of water has to be pumped steadily. There are good camp and office buildings. Twenty men were employed when visited.

Work at this prospect was stopped August 4, 1930. The latest work included a winze sunk 240 feet from the 350-ft. level, with some drifting from the bottom of it.

GOLD (PLACER MINES)

The production of gold from surface, drift and hydraulic mines has been small since 1914. Surface mining consists principally of summer work done along the banks and gravel bars of Yuba River below Smartsville by lone miners or small groups who have produced from $2,000 to $5,000 in all annually in this way from the tailings washed down each year. Several small drift mines, worked in a desultory way principally in the same district when water for washing is available in winter, have produced from $4,000 to $7,500 annually in late years. A long series of poor water seasons has hampered placer mining. There has been practically no hydraulic mining in Yuba County since 1917, when $5,934 was produced. The extensive gravel deposits at Smartsville, formerly worked by the hydraulic process, have lain idle in late years except for the desultory drift mining mentioned above. The Smartsville hydraulic diggings yielded an estimated total of $13,000,000, at the average rate of 37 cents a cubic yards, up to 1877. At Timbuctoo, Smartsville and Mooney Flat (the last named in Nevada County) it is estimated that 44,800,000 cubic yards have been hydraulicked and 33,400,000 cubic yards are available at present. The dredging fields at Hammonton on Yuba River owed its wealth in gold largely

to the fact that for many miles the modern Yuba River followed the course of the Neocene Yuba, deepening the ancient canyon and reconcentrating and sweeping downstream to the valley the gold content of the old stream from near French Corral to Mooney Flat, and from Timbuctoo westward for several miles.

GOLD DREDGING

The Yuba River dredging district, which has been the most productive in the state, extends along the river from the mouth of the rocky canyon to a mile west of Marigold, having a total length of about 7½ miles and a width of one to two miles. Because of the output of this district alone, Yuba County for years led all the counties of the state as a producer of gold. Dredging on Yuba River began in 1903 under the direction of W. P. Hammon and R. D. Evans. In 1905 their interests were acquired by Yuba Consolidated Gold Fields, which became the principal operating company here. This company has operated 18 dredgers in all. Marysville Dredging Company began work in 1906 and worked five dredgers, operating in the lower part of the field around Marigold until February 10, 1925, when they sold out to Yuba Consolidated Gold Fields. In 1916 Pacific Gold Dredging Company began work with one dredger at the upstream edge of the field and worked for several years, finishing their ground March 10, 1923.

The total area of proved dredging ground in Yuba River district was about 4,000 acres. From 1907 to the end of 1929, the total gold production of Yuba County has been nearly $67,000,000. When it is considered that nearly all of this gold came from dredging the 4000 acres mentioned (the production of other mines being small) a good idea may be formed of the richness of the field. The depth of ground that paid to dredge varied from 45 feet, on the fringes of the lower end of the field, to about 100 feet on the upper end. On the north side the dredgers now working are striking 'bedrock' at 50 to 60 feet in depth. The upper portion of the gravels in the flood channel, to a depth of 40 feet, consist of old tailings from the hydraulic mines formerly operated farther upstream. This generally carried not over six cents in gold per cubic yard. The so-called 'bedrock' under the pay gravel is the usual volcanic ash from the Sierra Nevada, altered and consolidated in some places. True bedrock was not reached in the lower part of the field. Drilling indicated two pay channels south of the present river, the older running southwest, with a poor streak between it and the upper channel which trended northwest. The gravel is generally medium to fine in size, and free wash, so that conditions have especially favored large scale operations at low unit cost. The peak of production occurred in 1921, when the gold yield of Yuba County was $4,738,248. For the entire period, 1907 to 1928, inclusive, the annual output has only twice dropped below $2,000,000 (in 1907 and 1924). From now on, however, gold production in that county will rapidly decrease.

Gold Dredges, Incorporated, Limited, quit operation of the Garden Valley dredger July 1, 1930. The land dredged is on Willow Creek about five miles from Camptonville by road. The deposit extends along the creek nearly a mile and is composed in large part of hydraulic

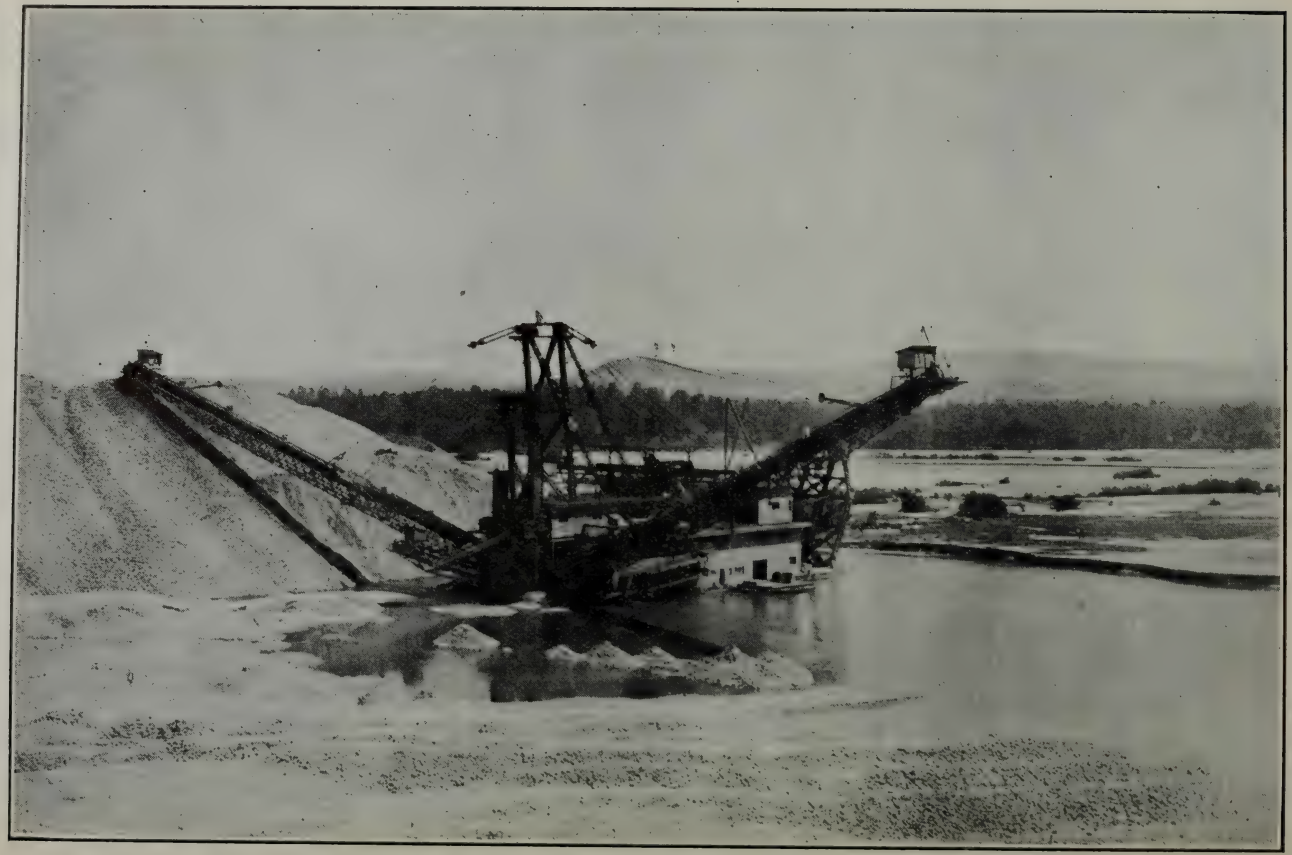
Bow view of Dredge No. 16, with two stackers, used to throw up restraining walls and to level the channel beds when dredging in Yuba River. Photo by courtesy of G. C. Aaronson, acting superintendent, Yuba Consolidated Gold Fields.

mine tailings from the Depot Hill Mine, but it is claimed there is some gravel in the creek that has never been worked on account of water and lack of grade. According to H. G. Kumle, who drilled the ground and helped start operation, the possible yardage of deposit was 2,300,000 cubic yards, of which 700,000 cubic yards have been dredged. From an indicated average value of 15.31 cents a cubic yard for the first five months, an average recovery of only about 65% is reported. The gravel is fine to medium in size.

The dredger was commissioned September 1, 1925, by Kumle and Kassabaum. Operation has been intermittent, the total time of working having been 16 months under various operations, indicating a monthly capacity of about 44,000 cubic yards. It was a second-hand outfit, carrying 43 buckets of 4½ cubic feet capacity and equipped with electric motors totaling 175 horsepower. It dug 16 to 20 feet below water level. Originally, it was said to lack sufficient table space but at present carries about 700 square feet of tables besides the save-all table. Seven men were employed when operating, but the dredger was idle when visited July 8, electric power having been cut off.

Yuba Consolidated Gold Fields. Main office, Boston, Massachusetts. Rene E. Paine, president. Charles W. Gardner, superintendent, Balfour Building, San Francisco. California operations are under management of Hammon Engineering Company, San Francisco. G. C. Aaronson, acting superintendent, Hammonton. This has been the largest and most productive gold dredging concern in the state. As mentioned above, the company was organized in 1905 by W. P. Hammon and R. D. Evans, with Hammon as managing director. The operations have been frequently described, particularly in Bulletin 85 of the State Mining Bureau (1918) and in the Fifteenth Report of the State Mineralogist (1915).

Nineteen dredgers in all have been operated by this company and its predecessors. Of these, the Yuba No. 1 and No. 2 were commissioned by Hammon and Evans in 1903 and 1904. Made by Bucyrus and by Western Engineering Construction Company, they had buckets of six cubic feet capacity, with shaking screens, and were capable of digging to a depth of 60 feet below the water line. From Yuba No. 3 to Yuba No. 12, inclusive, commissioned between 1905 and 1908, all had from 89 to 96 close-connected buckets of 7½ cubic feet capacity and revolving screens. These dredgers all had horsepower ratings of from 350 to 405, could dredge to a depth of 64 to 68 feet below the water line, and had monthly capacities of 125,000 cubic yards. Yuba No. 13, commissioned in 1910, was the first of the new series of large dredgers. It had 89 close-connected buckets of 16 cubic feet capacity, and its rated monthly capacity was 300,000 cubic yards. Yuba No. 14, commissioned in 1913, had the first all-steel hull. It carried 96 buckets of 16½ cubic feet capacity and could dig 78 feet below water level. This dredger worked 14 years, and in this connection the superintendent states that none of the company's steel-hulled dredgers has been worn out. Yuba No. 14 cost about $450,000 and the cost for each succeeding dredger increased. Yuba No. 15 to Yuba No. 18, inclusive, were similar in type and size to No. 14, except for greater depth capacity, having 98 buckets and digging 83 to 84 feet below water level.



Stern view of Dredge No. 16 of Yuba Consolidated Gold Fields, operating near Hammonton on Yuba River. Photo by courtesy of G. C. Aaronson, acting superintendent, Yuba Consolidated Gold Fields.

Yuba No. 16 (see photo) is equipped with two tailing stackers, in order to comply with regulations of the California Debris Commission regarding the disposition of tailing along streams tributary to Sacramento and San Joaquin rivers. Under a working agreement with that commission, whereby the gold dredging operations of the company and the commission's plans for straightening the Yuba River channel are coordinated, the double-stacker dredge digs two cuts each 400 feet wide, stacking tailing on each side of the cuts, which are thus separated by high rock piles. It is said that in ten years past, Yuba River has lowered its bed at Marysville eight feet by scouring.

When this company took over the holdings and plant of Marysville Dredging Company February 10, 1925, it renamed Marysville No. 5 dredge the Yuba No. 19. This has 87 buckets of 16 cubic feet capacity with a maximum rating of 872 horsepower, a depth capacity of 68 feet and is capable of a monthly output of about 400,000 cubic yards. The other large dredges (from Yuba No. 13 on) have ratings over 700 horsepower with digging motors of 440 horsepower each. Except for Yuba No. 19, which was built by Union Iron Works, San Francisco, all the dredges used by this company from Yuba No. 10 to Yuba No. 18, inclusive, were built by Yuba Manufacturing Company, a subsidiary of the dredging company which formerly had a plant at Marysville but has moved to San Francisco. This company has made dredges also for buyers outside the United States, including some for the present Russian government, for use in the platinum fields.

The exceptionally favorable dredging conditions with such a depth of free-wash gravel of small and medium size and the large scale of operations have been conducive to low operating costs. The following are figures for yardage handled, gross returns, costs, etc., for the period since 1915:

OUTPUT, OPERATING COSTS, ETC., YUBA CONSOLIDATED GOLD FIELDS, 1916-1929

Year	Yardage	Average yield, cents	Net total yield	Operating cost, cents a yard	Profits
1915-16	17,750,000	12.02	$2,133,528	4.27	$1,374,868
1916-17	18,490,000	14.86	2,748,197	3.99	2,009,500
1917-18	15,460,000	18.42	2,849,220	4.90	2,090,691
1918-19	15,996,000	19.49	3,117,791	7.22	1,962,426
1919-20	23,523,000	13.66	3,213,213	6.99	1,645,548
1920-21	23,148,000	15.16	3,510,170	7.48	1,779,584
1921-22	26,035,000	14.65	3,814,645	6.94	2,006,879
1922-23	24,039,000	8.50	2,043,305	4.55	1,056,863
1923-24	23,381,276	11.10	2,596,433	4.50	1,543,128
1924-25	17,490,671	9.43	1,649,010	5.19	739,928
1925-26					
1926-27					
1927-28	24,543,176	13.19	3,232,794	4.71	2,077,871
1928-29	24,948,295	8.81	2,196,846	4.53	1,066,124

The total yardage dredged from 1904 to February 28, 1929, was 426,289,205 cubic yards, which yielded a gross return of $58,254,035.95 and a net operating profit of $35,721,560.33.

Bean Boys Hydraulic Mine is one mile east of Clipper Mills and comprises in all 150 acres. R. J. Bean, Clipper Mills, owner.

In Penny Ravine, a branch of Hampshire Creek, there is a length of one-half mile where the gravel is 10 to 12 feet wide with a bank 10 feet high of which the two or three feet next the bedrock is claimed by the

owner to carry pay. The gravel is sub-angular with some quartz and some boulders 1-man size. The bedrock is decomposed gabbrodiorite.

In Clipper Ravine, where a length of one-fourth mile has been worked, the upper end of workings is 30 to 40 feet wide and the work was heading up the ridge in the direction of what may prove to be a remnant of an old channel, judging by the quartz boulders showing at the surface. The property has been idle most of the time since the last report but the owner plans work this season. The upper ditch with a capacity of 400 miner's inches gives a fall of 75 to 200 feet on the Clipper Ravine ground. The water supply will come from Grizzly Creek, requiring a mile of ditch. Bean plans to finish an hydraulic fill reservoir and a tailing dam of the same kind this season.

Hemstreet and Bell's sand plant on Yuba River near Marysville.

MISCELLANEOUS STONE

The Yuba River at Marysville carries large quantities of sand with only a small amount of gravel. The sand there carries a larger proportion of coarse-sized grains and is sharper than farther downstream. It is favorably known among contractors and engineers for highway construction and other concrete work, for gunite work and plaster sand. Small tonnages of pea gravel, concrete mix and washed gravel are also marketed. Three plants are at present in operation taking sand from the river.

At Hammonton and Marigold, on Yuba River 12 miles by road upstream from Marysville, lie immense piles of cobblestones, sand and gravel left by the gold dredgers. This is suitable for concrete work as the rocks are hard, fresh and clean breaking. No use is being made of this material at present because of lack of railroad facilities, but it forms a reserve which can be utilized at any time in the future. Over 400,000,000 cubic yards of gravel was dredged by one company alone near Hammonton.

Hemstreet and *Bell*. Office, 501 Eleventh street, Marysville. Sand and gravel plant is on Yuba River east of Seventh street.

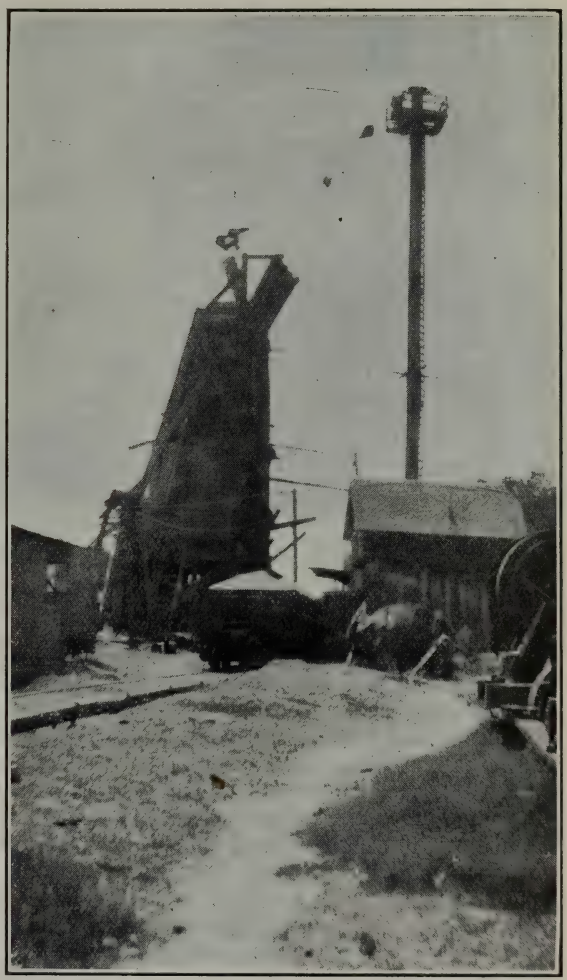
Sand with a small amount of gravel is dug from Yuba River with a drag-line outfit using a Pioneer bucket of one-half cubic yard capacity, operated by a 50-h.p. electric motor. The sand is dumped into a hopper, passing by gravity to a series of revolving screens which separate the different grades of sand and gravel. Concrete sand, plaster sand, pea gravel, and washed gravel are produced. The capacity of the plant varies with the distance the sand is carried by the bucket, but is at least 125 to 150 cubic yards daily. Storage is in bins from which trucks are loaded, and in outside stock piles. There is no rail connection to the plant. Three men are employed.

The company also uses small portable outfits on caterpillar mounts for digging sand and gravel during the low-water period at nearby places along the river.

Marysville Sand Company, Incorporated. Plant on south side of Yuba River opposite Marysville. Idle in July, 1930.

Pacific Coast Aggregates operates the plant at Marysville formerly belonging to Pratt Building Material Company, which was one of the companies consolidated in 1929 to form the new firm. The plant is on Yuba River at the south city limits. F. R. Lantz, local superintendent. Material is dug from an unpatented mining claim crossing the river.

A Sauermann dragline outfit operated by a 75-h.p. Washington hoist using electric power digs sand and gravel from the river and delivers it to the top of the washing plant, where it is screened and washed and passes to settling tanks, and to storage bins. Plaster sand, carrying sizes up to one-eighth inch, and



Sand plant of Pacific Coast Aggregates, Inc., at Marysville.

concrete sand up to seven-sixteenths inch size are the principal products. For gunite work sand must be dried in open bins. Small quantities of pea gravel and washed gravel are produced. The plant is served by spur track, permitting loading of railroad cars. Four men are employed and the capacity is about 400 tons a day.

The river during high water replenishes the supply of material by filling the pits dug in summer at the different plants.

Pratt Building Materials Company. (Company now consolidated with others to form Pacific Coast Aggregates, which see.)

Yuba River Sand Company. A. L. Brownlee, manager, and W. C. McBurney, superintendent. Office and plant on Yuba River at Marysville. This plant was leased to Pacific Coast Aggregates up to April, 1930, since which time the owners have resumed operation. It is the company's plan to rebuild the plant during the present year, with

Plant of Yuba River Sand Company at Marysville.

heavier machinery, a change in the method of digging and washing, and increased capacity.

At present a clamshell bucket of 1¼-cubic yards capacity run by a 75-h.p. electric motor and operated from a derrick moves sand from the river to the double screen, which runs under water, giving products through one-eighth and seven-sixteenths inch perforations. A second screening of the gravel gives pea gravel and washed gravel up to 1½-inch size. Bucket elevators raise sand and gravel to bins from which railroad cars can be loaded. A separate open bin is kept for drying sand for gunite. Concrete sand, plaster and brick sand, concrete mix, pea gravel and washed gravel for roofiing, etc., are produced. In summer a drag-line scraper is used to move sand to where it can be reached by the clamshell bucket. Four men are employed and a capacity of 1000 tons a day is claimed under good working conditions. When visited the plant was only producing a fraction of this amount on account of repair work.

PLATINUM GROUP METALS

Platinum, osmiridium and iridium have been produced as by-products of gold dredging for many years, although no complete statistics are available. These metals occur in very small quantities compared even to the gold content of the gravels, but the county has been the largest producer of them in the state because of the immense quantity of gravel washed. In the middle part of the field, one ounce of platinum group metals was recovered for each 50,000 cubic yards of gravel handled. In the lower section, around Marigold, only one ounce of the metals was produced from 380,000 cubic yards dredged.

The metals occur in very fine grains and thin flakes. Assays taken from lots of several hundred ounces over a period of several years showed 60.48% to 69.15% platinum, 14.67% to 18.96% osmiridium, and in cases of separate assay for iridium, 15.27% to 16.37% of that metal. The largest recorded annual production was 314 ounces in 1916, but since then the largest output was 189 ounces in 1918 and it has been less since, with the curtailed scale of operation incident to the exhaustion of the richer gravel.

Platinum group metals have been noted in the concentrate from some of the hydraulic mines in the county, but there is no record of production from such sources.

SAN FRANCISCO FIELD DIVISION

C. McK. Laizure, Mining Engineer

On account of unfinished field work, there is no report from the San Francisco Field Division in this issue.

LOS ANGELES FIELD DIVISION

W. B. Tucker and R. J. Sampson, Mining Engineers

SAN BERNARDINO COUNTY

History.

This county, which is the largest in the United States, was created by an act of the legislature in April, 1853. In spite of the fact that in 1893 part of its territory was allocated to the new county of Riverside, its present area of 20,157 square miles exceeds that of the states of Massachusetts, Connecticut, Rhode Island and Delaware combined. It was named for San Bernardino of Sienna, by the Franciscan priests who visited the valley south of the San Bernardino Range on May 20, 1810.

The city of San Bernardino was founded by Mormons from Salt Lake City in 1851.

Location and Description.

San Bernardino County lies in the southeastern part of California. It is bounded on the east by Arizona and Nevada, on the south by Riverside County, on the west by Los Angeles and Kern counties and on the north by Inyo County.

Of its area approximately 18,500 square miles is desert; the remaining 1657 square miles consists of the timbered south slope of the San Bernardino Mountains and a fertile valley which forms a part of the citrus belt of southern California. Its boundaries embrace perhaps 85 to 90 per cent of the area known as the Mojave Desert. This desert area is an arid waste of land, but it is far from being a level plain, spotted with sand dunes. It might be described as a succession of broad valleys between more or less continuous mountain ranges. Out of the floor of these valleys rise many isolated rugged buttes as well as low, rounded hills.

Elevations in the county range from approximately 350 feet to 11,485 feet above mean sea level. The lower elevation is at a point on the Colorado River in the southeastern corner of the county, while the highest one is at the top of San Gorgonio Mountain in the San Bernardino Range. Other high points are San Bernardino Peak, 10,630 feet, and Sugar Loaf Mountain, 9842 feet, both of which are in the San Bernardino Mountains.

Many topographic sheets pertaining to portions of San Bernardino County have been published by the United States Geological Survey and data of inestimable value on the history, topography, geology and water supply of this county are contained in Water Supply Paper 578 and accompanying maps, published by the same department. This publication is out of print, but may be consulted in the larger public libraries.

Transportation.

Lines of The Atchison, Topeka and Santa Fe, the Union Pacific, Southern Pacific, and Tonopah and Tidewater railroads cross the county, affording direct communication with trade centers and seaports.

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PHYSICAL SCIENCES LIBRARY

SAN BERNARDINO COUNTY—MINERAL PRODUCTION 1880-1929.

Year	Gold, value	Silver, value	Copper		Lead		Borates, value	Gypsum		Salt		Cement		Lime		Limestone		Brick		Marble		Miscellaneous stone, value	Gems, value	Miscellaneous and unapportioned		
			Pounds	Value	Pounds	Value		Tons	Value	Tons	Value	Barrels	Value	Barrels	Value	Tons	Value	M	Value	Cubic feet	Value			Amount	Value	Substance
1880																										
1881	$9 000	$100,000																								
1882	20,000	150,000																								
1883	30,000	1,050,000																								
1884	32,000	2,550,000																								
1885	23,000	2,363,436																								
1886	56,464	1,204,750																								
1887	27,850	1 133 268																								
1888	25 000	1 200 000																								
1889	10 737	621 820																								
1890	17 335	795 405																								
1891	62,970	711 157																								
1892	47,037	67 072																								
1893	158 000	447 020																								
1894	130 420	148 243					$726,509			1 000	$3,000	8 000	$21 600	40 000	$32 000	5,000	$6 250					$31 622				
1895	131,360	219 410					555,900			3 841	20,101	16 283	32,558	87 864	87,074	30,000	30 000					37 672				
1896	96 723	130,714					650,500			3 000	15 000	9 000	27,000	37 427	34,977	17 500	17,500			500	$3 000	23 476				
1897	100 373	54 407					1 680 000					18,000	66 000	12 000	12,000											
1898	201 512	32 000					1,120,000					50 000	150,000	50 000	35 000	6 600	6 600	2 000	$16 800	1,200	8,000	15 040				
1899	164 599	125 693	1,369,878	$232 339			1 106 000					60 000	180,000	16 000	16 100	16 440	14 810	1,000	8 000	4 500	625	11 275				
1900	247,049	172 759	1,920 000	297 600	10 000	$400	999 340					52 000	121,000	26 261	33,281	7 067	7 067					58 757	$20 000			
1901	399 893	57,164	50,000	7,875	500	20	893 130					71,500	159,842	38 753	43 028	54 210	76 710					159 727	20,000			
1902	394 936	58 973	338 480	41,068	59 340	2,076	2 193 609					90,000	273 600	76 582	65,852	48 956	51,578	60	1 800	6 005	15 600	102 400	11 600			
1903	351 197	59 199	60 400	7,832	14 000	504	495,000					100,000	157,000	30,923	58 692	52 813	64,613	100	8 000	38 000	41,600	236 661	16,000			
1904	595 828	13 925	169,477	17,270										25,000	21,500	28 421	42,575	2,500	17,500	31,116	53 400	168 656		4,000 cu ft.	$2 000	Sandstone
1905	473,893	19,595	52,603	8,206										17,024	14,740	27,387	51,395			40,100	40 000	147,197	65 000			
1906	354,830	33,765	514 031	99,207										20,910	17,146	19,837	35,990	1 800	13,500	7 200	25,000	38 476		10 tons	5 500	Tungsten
1907	155,676	81,339	514,282	102,856	34 211	1 822								8,600	8,600	74,709	139,188	1 665	15,555	6,482	29,946	147 942				
1908	180,511	35,704	516,040	71 079	409 576	17 218		20,000	$70 000	90	650					104 236	97,466	1 050	7,350	150	500	23,242	200			
1909	40,071	12,570	316,300	40,418	310,200	13,254		12,500	43,000	3 500	14,000					22,197	41,395	1 709	11,956	50,000	125 000	173 777	200	300 tons	3 000	Pottery clay
																									4,035 856	Unapportioned 1900-1909
																								430 tons	4 300	Pottery clay
1910	55,093	10,164	5,412	689	134 312	5,972		31,519	70,357	3,000	9,000					224,610	157,715	1,910	11,460			95 126	1,120	103 000 gals.	25 000	Mineral water
																								60 tons	840	Barytes
																								100 tons	1 000	Soapstone
1911	127,367	35 542	666,489	83,311	161 338	7,260		20,554	66,505	3 600	13 800					245 102	177,080			135	405	167 213		920 tons	4 060	Fuller's clay.
1912	293 900	49,962	1,937,185	319,636	94,852	4 268		21,000	67,000	3,600	12,600	2,301 000	2 996 200			80,188	97,867	1,340	8 040			550 824	450	350 tons	350	Pottery clay
																								200 tons	1 200	Mineral paint
																								50 tons	550	Barytes
1913	356,524	44 413	497 852	77,167	270,241	12 287		25 000	74,000	3,049	10,573			121,544	113 850	26,896	35 464	350	2,100			364 312	550	4,500 gals	25 000	Mineral water
																									1,341 304	Other minerals
																								44 100 gals	5 100	Mineral water.
1914	205,000	40,000	19,069	2,536	45,110	1,759		17,332	49,150	482	2,892			84,637	93,100	23,006	20 880	25	1 250			131,978		50 tons	561	Mineral paint.
																								140 tons	400	Glass sand
																									1,240 575	Other minerals
																								37 480 gals	7 370	Mineral water
1915	416,967	64,165	209,440	36,652	102,183	7,952				542	3,324	915 000	950,000			68 500	68,500	400	2,400			178 528		$64 tons	$46 947	Tungsten concentrates
																								39,818 lbs	4 441	Zinc
																									62 316	Dolomite, gypsum [illegible], manganese, marble, mineral paint, [illegible] and tale
																								7 600 cu ft	2 500	Granite
																								40 500 gals	6 500	Mineral water
1916	279 813	67,146	1,577,901	388 164	673 801	46,492				2,355	13,830	1,030 000	1,246,000	151,670	54,317	65,174	63,486					172 454	1,000	1 921 tons	3 915 434	Tungsten concentrates
																								707 062 lbs	91 716	Zinc
																									2 7 365	Brick, [illegible] fuller's, gypsum, manganese, mineral paint, pyrite, [illegible] and tungsten
																									2 350	Granite
																									187 541	Lime and limestone
																								235 tons	6,050	Manganese.
																								11,300 gals.	1 620	Mineral water.
1917	164,076	68,930	1,220,356	333,157	2,293,541	107,245						1,323,931	1,672,054									111,158		14 579 tons	2,019 129	Potash
																								3 050 tons	37 000	Strontium.
																								1 943 tons	2 447,726	Tungsten concentrates.
																								38 735 lbs.	3,051	Zinc
																									114,834	Brick, pottery clay, dolomite, feldspar, gems, gypsum, iron ore, mineral paint salt soda talc
																								270 tons	810	Dolomite.
																								601 500 gals.	60,150	Mineral water
1918	29,225	88,712	1,580,998	390,507	667 978	47,426						1,027,635	1,453 962			10,852	13 323					48,451		27 545 tons	3,428 443	Potash.
																								430 tons	4 210	Talc
																								2,900 tons	33 000	Strontium
																								1 347 tons	1 911,966	Tungsten concentrates.
																								2,824 lbs	257	Zinc
																									122,348	Gems, granite, gypsum, iron ore, lime, magnesite, manganese, marble, mineral paint, salt
																								800 060 gals.	32 006	Mineral water
1919	39,769	427,717	256,933	47,790	105,706	5,607		19,613	50,154			1,078,943	1,717,998									183 388		21 171 tons	1 670 949	Potash
																								3,601 tons	19 815	Talc
																									443 402	Borax, pottery clay, dolomite, gems, [illegible] tungsten
																								95 tons	800	Pottery clay
1920	70 195	1,212 987	5,388	991	115 576	,270	440,411			202	1,220	1,681 283	3 051 070									169,991		1,110 150 gals	156 726	Mineral water
																								15 435 tons	1 082 037	Potash
																									336 551	Dolomite, gems, granite, gypsum, iron ore, lime, limestone, soda, talc
																								083 tons	22 980	Calcium chloride
1921	217,568	3,210,706	17,054	2,200	22,812	1,027	338,905			13,270	67,762	1,964,926	4 633,437			21,862	106 195					145 572		7 [illegible] tons	211,067	Potash
																								2 756 tons	43 375	Talc
																									374,726	Pottery clay, dolomite, feldspar, gems, granite, gypsum, iron ore, lime, mineral water, pumice, soda
1922	125,728	2,374,918	13,452	1,816	11,188	615				12,222	54,259	2,770,953	4,156,430			2,200	7,800								1 826,304	Borax, calcium chloride, fuller's earth, gems, gypsum, lime, mineral water, potash, soda, talc, miscellaneous stone
1923	210,923	2,225 959	13,328	1,959	34,477	2,413				17,350	65,550	3,554,764	8,478,612			5,859	28,324					351,151		830 tons	12 630	Clay (pottery)
																								7 248 tons	123 216	Talc
																									2 278 516	Borates, calcium chloride, gems, gypsum, lime, mineral water, potash, soda (trona), tungsten concentrates.
1924	187,573	1,531,598	17,667	2,314	31 668	2,533				29,899	99,791	4,354,119	7 571,370			14,375	45,137					355,946		7,234 tons	125,926	Talc
																									2,720,243	Borates, calcium chloride clay (pottery), fuller's earth, gypsum, lime, mineral water, petroleum, potash, soda (trona), tungsten concentrates.
1925	157,374	1,378,392	6,249	888	61,480	5,349				28,319	101 085	5,079,281	8,828,044	17,495	124,446	13,239	27,569					395,048		1 640 tons	11,000	Clay (pottery)
																									3,150 468	Borates, calcium chloride, fuller's earth, mineral water, petroleum, potash, soda (trona), talc, tungsten concentrates
																								2 268 tons	10 605	Clay (pottery)
																								2,808 tons	73,721	Soda (trona)
1926	106 875	551,644	171,232	23,972	195,536	15,643				22,522	85,463	5,135,840	9 273 627	13,680	96,310	11,226	49,504					404,681		8,134 tons	142 250	Talc
																									3 384,150	Borates, calcium chloride, fuller's earth, magnesite, mineral water, petroleum, potash, silica, tungsten concentrates, zinc
																								1,788 tons	20,603	Fuller's earth
1927	82,225	447,125	107,132	25,824	125,892	7,919						5,557,339	9,823,839	12,170	92,383	550,011	348,384					311 470		6 844 tons	49,166	Talc
																									4 925 551	Borates, calcium chloride, clay (pottery), gems, mineral water, onyx, petroleum, potash, salt, silica, soda (trona), tungsten concentrates
																								2,190 tons	12,215	Clay (pottery)
1928	91,717	352 741	106,351	15,314	38,097	2,209				42,244	186,470	4,383,383	7,137,666	14,016	106,312	11,201	40,224					329,641			5,873,033	Antimony, borates, calcium chloride, fuller's earth, gems, mineral water, potash, soda, talc and tungsten
																										Clay (pottery)
1929	44,984	189,756	81,846	14,405	53 532	3,373				24,949	114,796	3,570,005	4,6[illegible] 1	10,145	77,340	15,520	40,763					629 111	1,540		5,171,414	Barytes, borates, calcium chloride, manganese, mineral water, potash, salt, soda, talc, tungsten
Totals	$7,894 760	$28 051 034	14,423,723	$2,[illegible]5,002	[illegible],153 331	$421,013	[3]$10,609,295	[3]167,548	$490,106	[3]218,845	$80[illegible],186	[illegible]46,281 485	$78 812 [illegible]57	[illegible]21 7[illegible]0	$2,208,694	[3]1,[illegible]04,228	$2,011 342	[3]15,909	$125,721	[3]185,388	$343,076	$6,830 243	[3]$131,660		$56,[illegible]1 760	

[1] Includes crushed rock, rubble, rip rap, sand, gravel.
[2] Combined annual production 1910, 1911, 1912.
[3] See under "Unapportioned."

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MAP OF SAN BERNARDINO COUNTY
SHOWING LOCATIONS OF
MINES AND MINERAL DEPOSITS

ACCOMPANYING REPORT BY W. B. TUCKER
JULY 1930

DIVISION OF MINES
WALTER W. BRADLEY
STATE MINERALOGIST

SCALE
0 10 20 30 MI.

78537 -Between pages 202-03

PHYSICAL SCIENCES

Two national highways traverse the county from east to west and many excellent state and county roads have been constructed in various parts of the county, greatly facilitating transportation and thus stimulating development of its natural resources.

Mineral Resources.

The mineral production from San Bernardino County is shown in the table printed herewith.

Prior to 1894 statistics on the production of gold and silver only are available. The recorded production through 1929 shows the imposing total of $189,983,096. Of this total perhaps $135,000,000 has been produced from the desert portion of the county. It is divided among 25 different substances, giving San Bernardino County a greater diversity of mineral wealth than any other county in the state.

The production of silver in the county was greatly augmented by the discovery of a rich deposit at Randsburg in 1919. This is known as the California Rand Mine and its total production has amounted to approximately $16,000,000, being for several years the largest single producer in the United States.

Another development in connection with silver mining in the county is the revived activity in the Calico District. Here the Silver King and Oriental properties have been taken over by the Zenda Mining Company and their development has disclosed new orebodies which may again put this old camp on a production basis. Encouraging results obtained by this company have been responsible for the reopening of the Odessa and Total Wreck mines. The mines of Calico District have a production record of over $10,000,000 in silver.

There is also a renewal of activity in the Virginia Dale District. Development work on the Virginia Dale Mine is now under way and much interest is being shown in other properties in this area. The development of an adequate water supply would no doubt result in a considerable production of gold from this district..

Improvement in the price of tungsten has led to the reopening of the mines at Atolia by the Atolia Mining Company. Two concentrators have been erected, having a combined capacity of approximately 900 tons daily. The 750-ton plant operates on gravel from the 'Spud Patch' at the southeast end of the tungsten area, while the 150-ton plant is treating ores from the Union Mine and various dumps scattered over the property.

Two large plants on Searles Lake have been in continuous operation extracting potash, borax and soda from the brines of the lake. The American Potash and Chemical Corporation's plant at Trona produced 138,291 tons of potash and borax salts during 1928. The net operating profit for the year amounted to $1,556,541. The corporation is producing and marketing today 25 per cent of all the potash used in America and about one-third of the borax used in the world. It is stated that the corporation plans to double the capacity of the present plant during the year 1930.

In the following report on the mineral resources of the county, the metals are taken up in alphabetical order and the mines discussed in like manner, no segregation into the various mining districts being made.

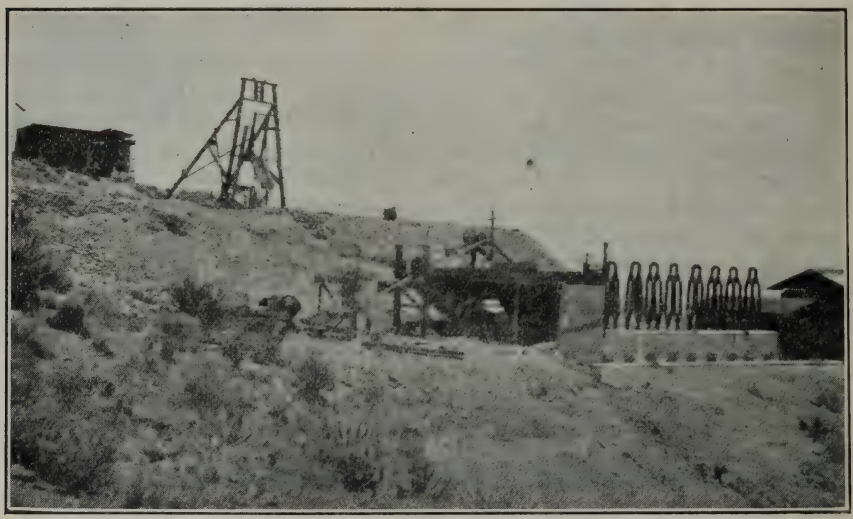
Descriptions of the nonmetallic deposits follow and are arranged in the same manner.

On the accompanying map are shown the locations of the various mines and mineral deposits.

San Bernardino for several years has led all other counties in the state in point of variety of minerals, producing commercially during 1929 a total of 22 different substances, the following being included among its resources: Asbestos, barytes, borax, cement, clay, copper, gems, gold, granite, gypsum, iron, lead, limestone, manganese, marble, mineral paint, mineral water, nitre potash, salt, soapstone, soda, strontium, talc, tungsten, vanadium and zinc.

ANTIMONY

Only a few tons of this metal have been produced in the county. Due to the unstable market and inability to compete with the Chinese products there has been little incentive to prospect for this substance.



Shaft and furnace. Desert Antimony Mine, San Bernardino County.

Desert Antimony Mine. The property is situated in the Clark Mountain District, about 12 miles southwest of Roach, Nevada, a station on the Union Pacific Railroad. Elevation 5000 feet. Owner, J. J. Wade, Nipton, California. The property was operated under lease during 1927 and 1928 by *Triangle Mining Company* of Los Angeles. This company shipped 18 tons of ore, with metallic content of 40.3 per cent antimony. Holdings consist of 3 claims: Desert Antimony, Desert Antimony Extension and Hongkong, totaling 60 acres.

The country rock is granite. Three parallel veins occur in the granite, their strike being N. 20° E.; dips vary from 75 degrees west to vertical. Width of veins vary from 2 to 4 feet. These veins are about 50 feet apart and most of the development work has been confined to the west vein. The ore so far developed occurs on the footwall, and the high-grade ore has a width of 12 inches to 2 feet. It is reported that

ore mined carried from 15 to 20 per cent antimony and was sorted to carry from 40 to 60 per cent antimony. The ore is in the form of stibnite (Sb_2S_3).

Development: On the east vein, a tunnel has been driven west 30 feet to the vein, at which point a winze has been sunk to a depth of 30 feet. From the bottom of the winze a drift has been run 40 feet on the vein. This work has exposed a vein four feet in width with two feet of ore on footwall. West vein: On this vein a shaft has been sunk to a depth of 100 feet. At a depth of 50 feet there is a drift north 100 feet and south 40 feet. The vein material exposed in these workings consists of quartz, calcite and barite, mineralized with stibnite. In the north drift the vein has been stoped for a length of 80 feet to the surface. The ore extracted from this stope is reported to have carried from 30 per cent to 50 per cent antimony. In the bottom of the shaft there is 6 inches of high-grade ore. About 300 feet south of the shaft and 100 feet vertically below the collar of the shaft, a tunnel has been driven south 150 feet on the west vein. The middle vein has been developed by a number of open cuts for a distance of 1000 feet along its outcrop.

Mine equipment consists of 12-h.p. Western gas engine hoist. Reduction equipment consists of one 10-ton furnace. Idle.

COPPER

The total value of copper produced in San Bernardino County through the year 1929 is $2,395,002.

Although copper is widely distributed throughout the mountain ranges of the desert area of the county, the annual production since 1918 has been small due largely to the unsettled market conditions and low prices prevailing.

The districts which have produced the largest tonnage of copper ores in the past are: Ivanpah, Ibex, Old Dad Mountain, Signal, Silver Mountain and Whipple. The largest single producers have been the Copper World Mine in the Ivanpah District and the Pacific Mines Corporation properties, seven miles south of Ludlow. Both of these properties operated until the latter part of 1918. Some interest is now being shown in the possible development of deposits in the Ord Mountain area.

Allured Copper Mine, consisting of 9 claims, is situated 12 miles northeast of Cima and immediately south of the New Trail Mine. Elevation 4200 feet. Owner, M. E. Allured, Jackson, Amador County, California.

A series of copper-bearing veins having a north-south strike occur in the limestone. The copper is in both the carbonate and sulphide form. Shipments made in the past are reported to have carried 8 per cent to 20 per cent copper.

Development consists of two shafts each 125 feet deep. Idle.

Bibl: State Mineralogist's Report XVIII, p. 611.

Amazon Mines consist of 6 claims in the Silver Mountain District, 6 miles east of Oro Grande. Owners, F. H. Cline et al., Oro Grande, California.

Oxides of copper occur in a contact vein between limestone and diorite. Development consists of two shafts 265 and 175 feet deep, respectively, and several tunnels. Shipments aggregating 300 tons were made several years ago. Idle.

Bibl: State Mineralogist's Reports XI, p. 363; XII, p. 69; XIII, p. 60; XV, p. 784.

American Eagle Group. It consists of 19 claims in the Whipple Mountain Mining District, in Sec. 32, T. 3 N., R. 4 E., S. B. M., 13 miles north of Vidal, the shipping point. Owner, *American Eagle Gold and Copper Company.*

The property was developed by 130-foot shaft and some drifts said to have exposed a large body of low-grade sulphide ore, varying up to 10 per cent copper and from $2 to $21 in gold. The values are erratic and it is a highly siliceous ore. A shipment which assayed 6.35 per cent copper, carrying 65 to 75 per cent silica was so heavily penalized on this account that the shippers received no returns. Idle.

Bibl: State Mineralogist's Report XV, p. 784; Bull. No. 50, p. 337.

Bagdad-Chase Mine. (See under Pacific Mines Corporation.)

Big Butte Mine. It is in the Ibex District, 6 miles west of Needles. Elevation 1100 feet. Owner, K. K. Horan, Needles, California.

The ore contains gold, silver and copper. Development consists of 125-foot shaft and numerous short tunnels and open cuts. One car load was shipped to the Needles smelter in 1913. Idle.

Bibl: State Mineralogist's Report XV, p. 785.

Black Diamond Mine. It is in the Silver Mountain District, 8 miles east of Oro Grande. Owner, Joseph Scheerer Estate, Victorville, California.

Gold, silver and copper occur in a vein along the contact of a porphyritic dike and granite. A shaft 150 feet deep and several small cuts comprise the development work. Idle.

Bibl: State Mineralogist's Report XV, p. 785.

Black Metal Mine, consisting of 3 claims, is described as being 50 miles southeast of Needles, about 3 miles west of the Colorado River. Owner, George B. Parks, Barstow, California.

Development consists of tunnels 75 feet, 40 feet and 10 feet, respectively. Ore is chrysocolla and horn silver. Idle.

Bibl: State Mineralogist's Reports, XII, p. 376; XIII, p. 606.

Black Mountain Mining Company owned 96 claims in T. 10 N., R. 21 E., 9½ miles west of Needles. Nick Johriess of Needles was president of the company. Idle.

Bibl: State Mineralogist's Report XV, p. 785.

Bumper Group, consisting of 6 claims, is 12 miles south of Needles. Elevation 1200 feet. Owners, E. H. and H. A. Norton, Needles, California.

The ore is said to contain malachite and azurite. Development consists of 22-foot shaft and connecting 65-foot adit. Idle.

Bibl: State Mineralogist's Report XV, p. 785.

Calarivada Mine, consisting of 2 claims, is located in the Clark Mountain District, in T. 18 N., R. 13 E., S. B. M., 23 miles west of Goodsprings, Nevada. Elevation 5000 feet. Owner, *Colosseum Mines Corporation.*

Copper ore occurs in the bedding planes along a northwest-southeast fracture in limestone. Dip is 40° E. The vein is from 2 to 4 feet wide, carrying copper oxides and chlorides of silver. Shipments are reported to have shown 10 per cent copper and 15 ounces of silver.

Developed by a vertical shaft 200 feet deep, with 200 feet of drifts on the 100-foot and 200-foot levels. Idle.

A northwest-southeast vein in limestone from 2 feet to 4 feet wide, carries azurite, malachite, silver chlorides and some gold values in a quartz and silicified limestone gangue. Developed by a 200-foot vertical shaft with 200 feet of drifting on the 100-foot and 200-foot levels.

Equipment consists of 12-h.p. gasoline hoist. Idle.

Bibl: State Mineralogist's Report XX, p. 93.

California Gold Copper Company's mine consists of 9 patented claims in the Signal District, 9 miles north of Goffs. Elevation 3700 feet.

The property was equipped with electrolytic copper and 160-ton cyanide plants. Idle for years.

Bibl: State Mineralogist's Report XV, p. 785.

Camp Vera Group is in the Morrow District, 25 miles north of Barstow. Idle.

Bibl: State Mineralogist's Report XV, p. 785; Bull. 50, p. 334.

Claw Hammer Group consists of 4 claims in the Belleville Mining District, in the Ord Mountains, 6 miles southeast of Daggett. Owner, Jens Youngreen of Los Angeles.

Mineralization consists of chalcocite and malachite, occuring along fractures in a quartz monzonite near its contact with rhyolite. Strike of this belt is NE.-S.W., dip 70° to the east. Width varies from 4 feet to 12 feet. Development consists of 30-foot shaft. Idle.

Columbia Mine. (See under Silver.)

Copper Basin Consolidated Mines Company's property, consisting of 9 claims, is in the Monumental Mining District, about 15 miles north of Parker, Arizona. Elevation 1000 feet above sea level.

Here two well-defined zones of mineralization occur in quartz porphyry. The strike is north-south, dip from vertical to 45° east. One of these zones has a width of from 5 feet to 40 feet and is traceable on the surface for about 2000 feet.

Mineralization to a depth of about 100 feet consists of copper carbonates, with some oxides.

The development work consists of open cuts, tunnels and shallow shafts. One shaft is 100 feet deep and shows an 8-foot vein assaying

Ivanpah Copper Company's smelter. Valley Wells, San Bernardino County.

Copper World Mine. Ivanpah Copper Company, Clark Mountain District, San Bernardino County.

5 per cent copper. The bottom is in the sulphide zone, the ore consisting of chalcopyrite, pyrite and bornite. Some 600 feet from this shaft, an 80-foot shaft has been sunk on another vein. In the bottom this shaft appears to be entering a sulphide zone. Idle.

Bibl: State Mineralogist's Reports XVIII, p. 308; XIV, pp. 99–100, q. v.

Copper Bell Group, consisting of 8 claims, is in the Monumental District, 12 miles northwest of Drennan, a station on The Atchison, Topeka and Santa Fe Railroad.

The ore, carrying values in copper, gold and silver, occurs in quartz veins in granite. Idle.

Bibl: State Mineralogist's Report XVII, p. 339.

Copper Commander Group consists of 4 claims in the Clark Mountain, 22 miles north of Cima, in T. 16 N., R. 13 E., S. B. M., and adjoins the Copper World Mine on the northwest. Elevation 5500 feet. Owner, Mike Conway, Cima, California.

The ore on this property occurs in a broad mineralized zone at the contact of granitic porphyry with limestone, the porphyry being intrusive into hard, gray-colored limestone. The copper ores occur throughout the porphyry for a considerable distance from the contacts. In the mineralized zone, which is about 200 feet wide and has a general northwest strike, veinlets of copper oxide ore occur. The ore is low grade, said to average about 4 per cent copper.

Development consists of a tunnel driven southeast on the contact a distance of 140 feet, also a number of short tunnels and open cuts, all of which expose some ore. Idle.

Bibl: State Mineralogist's Report XX, p. 93.

Copper World Mine. (Tip Top Mine. See under Gold.)

Copper World Mine is located in Clark Mountain, Clark Mining District, T. 16 N. R. 13 E., S. B. M., 20 miles northwest of Ivanpah, a station on the Union Pacific Railroad. The property, consisting of 4 claims, lies at an elevation of 5180 feet. Owner, *Ivanpah Copper Company;* Dan Murphy, president; Dr. L. D. Godshall, general manager, 722 South Oxford, Los Angeles.

The property was operated by present owners from 1916 through the early part of 1919.

The mineralized zone which, in places, has a width of 200 feet, occurs at the contact of limestone and porphyry.

The property is developed by several thousand feet of underground workings, driven from three tunnel levels. The ore was smelted at Valley Wells, 5 miles southwest of the mine, in a 100-ton blast furnace.

For more detailed description see Seventeenth Report, p. 339. Idle.

Bibl: State Mineralogist's Reports XIII, p. 61; XV, p. 786; XVII, pp. 339–340; Bull. 50, pp. 326–328.

Confidence Copper Mine is in Sec. 5, T. 11 N., R. 14 E., S. B. M., in the Kelso Mining District, 4 miles southeast of Ames, a station on the Union Pacific Railroad. Holdings consist of 4 mining claims on the southwest slope of the Providence Mountains, at an elevation of 4000

feet. Owner, Confidence Copper Mining Company; Edward Bluett, secretary, Los Angeles.

The mineralization, consisting of chalcopyrite, pyrite, wolframite and gold, occurs in two true fissure veins, which have been formed on the contact of granite with a porphyritic rock, strike is east-west, dip 65° to the south. These veins are known as the Confidence and Francis. Vein filling is quartz and mineralized granite.

Development work consists of 100-foot shaft sunk on a 65° inclination and a number of shallow shafts and open cuts. Idle.

Bibl: State Mineralogist's Report XVII, p. 340.

D. and W. (Dayton and Wilbur) Mine is in the Whipple Mountain District, 13 miles north of Vidal. It adjoins the American Eagle Group. Elevation 1800 feet. Owner, D. and W. Mining Company. Former address, 808 San Fernando Building, Los Angeles; Joseph Simon, secretary.

The ore containing malachite, azurite and gold occurs in a porphyritic dike in diorite. Property was formerly equipped with a 50-ton mill. Idle.

Bibl: State Mineralogist's Report XV, p. 786; Bull. 50, p. 337.

Desert Butte Group is 40 miles southeast of Amboy and 3½ miles south of Kilbeck. Owners, George B. Parks and A. J. Crowley, Barstow, California.

Some shipments of complex ore, containing copper, gold, silver, lead and zinc, were made to Selby smelter in 1914. Idle.

Bibl: State Mineralogist's Report XV, p. 786.

Desert Queen Copper Mines Company. It was reported that this company was operating a property in the northern part of the county and that shipments of ore were made to the International smelter in Utah. No further information available. Presumably idle.

Emperor Mine. (See under Lead-silver.)

Foster Mine. This property, consisting of 22 claims, is situated in T. 17 N., R. 11 E., S. B. M., in the Shadow Mountain District, 25 miles east of Silver Lake. Owner, Foster Mines Company; E. D. Foster, president and general manager, 124 West Fourth street, Los Angeles.

A series of parallel veins in porphyry and schist carry values in copper, gold and silver. Three shafts have been sunk on different veins; greatest depth 125 feet. Idle.

Bibl: State Mineralogist's Report XVII, p. 341.

Francis Copper Mine, comprising 8 claims, is located in the Kelso District, on the southwest slope of the Providence Mountains, 4 miles southeast of Ames, a station on the Union Pacific Railroad. Elevation 4350 feet. Owner, Francis Copper Mining Company; C. Colcock Jones, president; C. H. McWilliams, secretary, 1014 Quinby Building, Los Angeles.

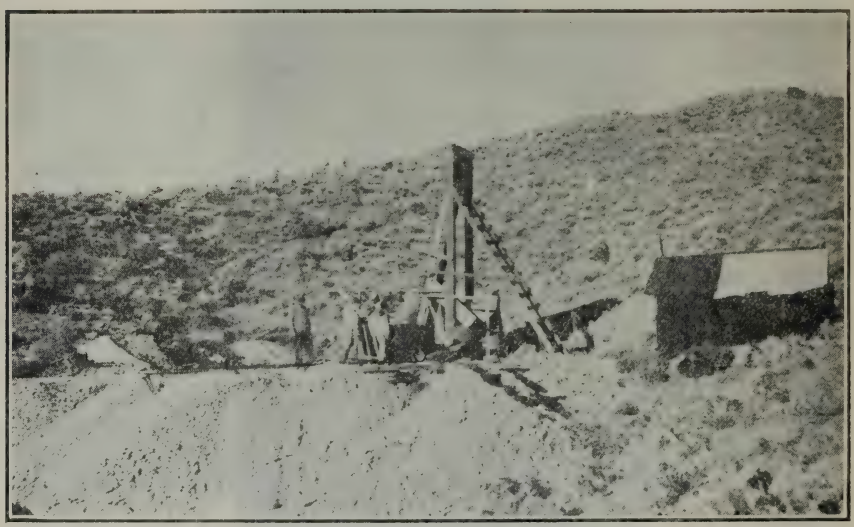
A gneissic-schistose formation of pre-Cambrian age has been intruded by dikes of quartz-porphyry and diorite, with the creation of a vein-

Cuyamaca and Woods shafts. Francis Copper Mine, Kelso Mining District.

dike system and replacement area coincident with a northeast-southwest fissuring. This has resulted in one major vein, on which the present work has been done and a number of parallel and intersecting veins, in a width of 1200 feet, the length of the zone being 4500 feet.

There are three principal, parallel porphyritic intrusions and accompanying vein-dikes. The Western Star, which is the most northerly one, is a quartz-porphyry dike up to 70 feet in width.

The Cuyamaca-Woods dike No. 3 outcrop can be traced for more than 2500 feet. It has been developed by two shafts. The Francis shaft, being 140 feet deep, has been further developed by some 600 feet of drifts and crosscuts. The Woods No. 2 shaft has been sunk on the same ledge some 1500 feet west of the Cuyamaca, to a depth of 40 feet. Here the quartz outcrop is from 6 to 30 feet wide and the shaft has disclosed 6 feet of quartz. Values in this vein are more or less oxidized



Headframe and hoist. Francis Copper Mine, Kelso Mining District, Providence Range of Mountains, San Bernardino County.

and leached, but there is an 18-inch streak in the center which carries copper-silver values in the sulphide form.

The outcrop of the Cuyamaca vein, in which the principal development work to date has been done, is from 10 to 50 feet wide and may be traced for a distance of 2500 feet. The ore is silver, copper, lead and zinc sulphides in a quartz gangue. The values are reported to be as follows: Silver 2 to 25 ounces, copper 2 per cent to 12 per cent, lead 2 per cent to 6 per cent, and zinc 4 per cent to 20 per cent. The Francis shaft on the Cuyamaca claim is 140 feet deep and is connected on the 70-foot level with the bottom of another shaft by a drift which is 160 feet long. A total of 600 feet of drifting and crosscutting has been done here. The vein varies from 3 to 4 feet in width and shipments are reported to have given smelter returns of 12.3 ounces silver and 2.35 per cent copper, no payment being made for lead or zinc.

In 1917–18 shipments from the Cuyamaca shaft aggregating 307 tons were made to the Valley Wells smelter. Of these shipments the last 5

cars averaged 10.2 ounces silver and 2.19 per cent copper, with no payment for lead or zinc, the average of the 307 tons being 7.9 ounces silver and 1.7 per cent copper.

The Godshall shaft, 450 feet southwest of the Francis shaft, has been sunk to a depth of 100 feet on the hanging wall of the Cuyamaca vein, which dips 70° to the north. This work exposed a vein 6 feet in width, with reported assays from the material on the dump of 12.2 ounces of silver and 1.2 per cent copper.

Average value of ore from the 70 and 136-foot levels of the Francis shaft are reported as follows:

70-foot level—15.7 oz. silver, 9.45 per cent copper.

136-foot level—2.72 oz. silver, 3.08 per cent copper, 16.20 per cent zinc.

The above-mentioned values are across widths of from 3 to 4 feet.

Equipment consists of 6-h.p. gas engine, hoist and gallows frame at the Francis shaft, together with bunk house and boarding house. Idle.

Bibl: State Mineralogist's Report XVII, p. 341.

Giant Ledge Gold and Copper Mine is in the New York mountains, 10 miles northwest of Ledge, a station on the Ivanpah branch of the Santa Fe Railroad. Elevation 5700 feet. Presumably idle for many years.

Bibl: State Mineralogist's Report XV, p. 786; Bull. 50, p. 333.

Halloran Springs Mine, comprising 4 claims, is situated in an unknown mining district, in T. 14 N., R. 10 E., S. B. M., 15 miles southeast of Silver Lake Station, on the Tonopah and Tidewater Railroad. Elevation 2500 feet. Owners, Charles A. Kellogg and C. V. Welch, Los Angeles.

The country rock consists of granite and andesite. The ore occurs along a shear zone in an andesitic porphyry. This zone is from 20 to 50 feet wide. Its strike is NW.-SE. and the dip is vertical. The mineralization consists of azurite, malachite, silver chlorides and bromides, with some gold values.

Development consists of some shallow shafts, not exceeding 30 feet in depth and an open cut. Idle.

Hercules Group in the Hikorum (Old Dad Mountain) District, is 9 miles north of Bagdad. Elevation 3200 feet. Owner, Robert Andrews, Bagdad, California.

Veins occur in a fine-grained quartz porphyry and carry carbonates of copper with some gold values. Developed by a 42-foot shaft and several open cuts. Reported to have shipped 1400 tons of ore, varying from $6 to $8 in value. Idle.

Bibl: State Mineralogist's Report XV, pp. 786–787.

Hermit Mine, formerly known as Blue Jacket. (See under Silver.)

Hidden Hill Mine. (See under Gold.)

Hidden Treasure Copper Mine is in the Signal District, 12 miles east of Goffs. Elevation 2450 feet. Owners, A. L. Morehead and W. F. Chausse, Goffs, California.

Ore occurs on contact of granite and schist. Strike N. 40° W., dip 45° SE. Developed by a series of prospect holes and trenches and one shaft 160 feet deep. Idle.

Bibl: State Mineralogist's Report XVII, p. 341.

Home Mine is in the Hikorum (Old Dad Mountain) District, 12 miles north of Bagdad. Elevation 2960 feet. Owners, L. V. Root and Joseph Luxon, Needles, California. Idle.

Bibl: State Mineralogist's Report XV, p. 787.

Hoosier and Missouri Groups are in Sec. 28, T. 10 N., R. 3 W., S. B. M., 12 miles northwest of Barstow. Owners, J. W. Foglesong and E. Troutman, Barstow, California.

Ore carrying gold, silver, copper and lead occurs in a quartz ledge, said to vary up to 15 feet in width, on a contact of rhyolite and granite.

Development consists of a 90-foot shaft and 300 feet of drifts. Idle.

Bibl: State Mineralogist's Report XV, p. 787.

Ivanpah Mine is in the Ivanpah District, about 27 miles north of Ivanpah, in T. 16 N., R. 15 E., S. B. M. Idle.

Bibl: Bull. 50, p. 330.

Ivanpah Mammoth Mine is in the Ivanpah Mountains, about 5 miles from Ivanpah, in T. 15 N., R. 14 E., S. B. M. Idle.

Bibl: Bull. 50, p. 330.

Jachon Mine is 12 miles north of Barstow and 6½ miles northeast of Williams Well. Elevation 4000 feet. Owner, R. M. Dillingham, Barstow.

Three fissure veins in granite, varying from 8 inches to 4 feet in width, carry oxidized ores of copper and gold. Strike NE.-SW. Development consists of 120-foot shaft sunk on 70° incline and 60 feet of drifts. Idle.

Juanita Group, in the Morrow District, adjoins the Juanita Mine. Idle for many years.

Bibl: Bull. 50, p. 335.

Juanita Mine is in the Morrow District, 26 miles east of Johannesburg. Idle.

Bibl: Bull. 50, p. 335.

Josie K. Mine is in the Ibex District, 6 miles west of Needles and 3 miles south of Hartoun. Idle.

Bibl: State Mineralogist's Report XV, p. 787.

Lake View Mine is in the Silver Lake District, 16 miles south of Silver Lake station on the Tonopah and Tidewater Railroad.

The ore occurs on a contact of porphyry and limestone, and consists of chalcopyrite.

Developed by 50-foot shaft and 600 feet of tunnels. Idle.

Leastalk Gold and Copper Company is in the Barnwell District. Idle.

Bibl: State Mineralogist's Report XV, p. 787; Bull. 50, p. 330.

Leastalk Gold and Copper Mining Company has 12 claims in the Vanderbilt District. Idle.

Bibl: Bull. 50, p. 336.

L. and L. Group of Mines, comprising 17 claims, is located in the Ord Mountain District, in Sec. 17, T. 7 S., R. 3 E., S. B. M., 9 miles southeast of Newberry Springs. Owner, L. and L. Mining Company; O. A. Lau, president, Riverside, California.

Several roughly parallel veins occur in this property. On the Gigantic claim a shaft sunk to a depth of 50 feet on a 50° inclination follows a vein, the strike of which is NW.-SE., dip 50° SW. This quartz vein, 12 inches to 18 inches wide, contains malachite, azurite, bornite and chalcopyrite. The footwall is diorite and the hanging wall is monzonite. Reported values up to $15 gold and 9 per cent copper. In the hill to the northwest of this shaft, a crosscut tunnel was driven 469 feet N. 70° E. and has about 200 feet to go before intercepting this vein.

Some 300 feet east of the shaft is another quartz vein, strike N. 10° E., dip 75° W. It is 3 feet wide and the ore in the vein is from 12 inches to 18 inches wide.

Lucky Jim Mine, consisting of 5 claims, is in the Old Woman Mountains, T. 1 N., R. 21 E., S. B. M., about 20 miles north of Milligan, a station on the Parker cut-off of the Santa Fe Railway. Elevation about 2700 feet. Owner, E. J. Morath, 521 Walnut street, Long Beach, California. Under lease to F. A. Crampton, on the property.

Quartz vein accompanies a porphyritic dike in granite. As is usual in this type of vein, the lenses are found on either wall of the dike and probably overlap. Strike is N. 65° W., dip about 85° N. The vein is reported to average 4 feet in width. The vein matter is a vitreous quartz. Minerals observed were chlorides and bromides of silver and chalcopyrite. Occurrences of argentite and ruby silver are reported, but none were seen. The principal values are in silver.

Shipments aggregating approximately $35,000 in value have been made since the opening of the mine in 1911. These shipments of selected ores are reported to have run from 200 to 400 ounces of silver, $3 to $4 gold, about 5 per cent copper and 5 per cent lead.

Principal development consists of 500 feet of crosscut tunnel driven north, which is connected with the surface by means of a 200-foot shaft. This shaft was the original opening and considerable work was done in it between the tunnel level and surface, which is now inaccessible. No doubt all ore above the tunnel has been stoped. On the tunnel level, a drift west has been driven about 200 feet and one east for a distance of 150 feet. A winze 85 feet deep was sunk at the intersection of the crosscut and drifts. At 150 feet west of the crosscut, a winze has been sunk to a depth of 35 feet and at about 165 feet west of the crosscut there is a 100-foot raise. As stoped the ore shoot appears to have been from 75 feet to 100 feet long.

Three men are employed sinking the west winze, which is now 35 feet deep, and a drift north has been started at the bottom.

Equipment consists of compressor, driven by tractor engine, drills, Little Tugger hoist at winze, blacksmith shop, and 3 cabins. A three-mile pipe line brings water to the camp from a spring.

The present operator is directing his efforts towards the development of sufficient ore to warrant the erection of a mill.

Mohawk Mine. (Ivanpah Copper Co. See under Lead-silver.)

New Trail Mine, comprising 28 claims, is located on the east slope of the Ivanpah range of mountains, 11 miles northwest of Cima, a station on the Union Pacific Railroad. Elevation 5000 feet. Owner, New Trail Mining Company; J. F. Kent, president, Box 867, Riverside, California.

Here a bed of limestone some 2500 feet in thickness, strike N. 30° W., dip 45° NE., lying between granite walls, has been intruded by dikes of monzonite. This limestone has been faulted along a northeast-southwest line, with a throw of several hundred feet.

A dike, consisting largely of garnet and epidote, strike N. 40° E., dip 80° NW., cuts across the bedding planes of the limestone. A two-compartment shaft was started on this dike. To a depth of 100 feet the shaft followed the dike, but from the 100 to the 200-foot level the shaft is in the hanging wall of the dike. On the 100-foot level at a distance of 20 feet southwest of the shaft, the dike is faulted to the northwest, showing a displacement of 20 feet. The ore which formed in this fracture and for a few feet in the bedding planes on each side, has been stoped to the surface. The dip of the fracture is 50° SW. At 150 feet southwest of the shaft, a high-grade ore consisting of bornite and chalcopyrite, was encountered on the northwest side of the dike. The fracture along which this ore has formed crosses the dike at a distance of 170 feet from the shaft. At 235 feet from the shaft there is a third, parallel cross-fracture. The drift continues for a total distance of 400 feet southwest of the shaft. There is also a drift northeast from the shaft, 120 feet. No ore was encountered in this drift.

On the 200-foot, which is the bottom level, at 125 feet southwest of the shaft, there is a NW.-SE. cross-fracture, which is mineralized. A drift has been driven northwest for a distance of 35 feet on this ore. At 30 feet from the main drift, a winze has been put down to a depth of 50 feet. There is also a small stope above the level at this point. Irregular bunches of chalcopyrite and bornite were found here and two cars of this ore were shipped. It is reported that returns from these shipments showed $5 in gold and from 8 per cent to 15 per cent copper. The drifting on this level followed the dike in a southwesterly direction for a distance of 440 feet. In the face of these workings, a tongue of serpentine was encountered. A 50-foot drift was also driven northeast from the shaft.

About 3000 feet south of the shaft, a N.-S. fracture, dip 50° W., has been worked to a depth of 80 feet and some 200 feet east of this shaft. Here, a zone some 40 feet in width is copper stained and the mineralization consists of copper carbonates and oxides.

On the south end of the claims there is a series of fractures, the strike varying from N. 60° E. to N. 40° W. All of these show mineralization along the intersections.

Equipment consists of 15-h.p. Fairbanks-Morse gas engine hoist and 300-cu.ft. Chicago pneumatic compressor.

Present explorations are with a churn drill. Two men employed.

New York Mine. (See Sagamore Mine.)

Orange Blossom Mining and Milling Company, in the Hikorum (Old Dad Mountain) District, 9 miles north of Bagdad, has been idle for several years.

Bibl: State Mineralogist's Report XV, p. 788; Bull. 50, pp. 338–339.

Orange Blossom Extension Mine adjoins the Orange Blossom property on the north. A mill was erected here, but only ran a short time. Idle.

Bibl: State Mineralogist's Report XV, p. 789; Bull. 50, p. 340.

Ord Mountain Mine (formerly known as the Osborn Group). This property, consisting of 8 patented claims and 20 claims held by location, is in the Ord Mountain District, 14 miles southeast of Daggett. Elevation ranges from 4000 to 5500 feet. Owner, Frank A. Werner, 2029 West Washington street, Los Angeles. Under option to *Ord Copper Company, Ltd.,* Courthouse, Las Vegas, Nevada. J. L. Carder, president and general manager; George B. Hayden, treasurer, 225–227 I. W. Hellman Building, Los Angeles.

The patented claims are the Coupon, Tehachapi, Brilliant, Central, Rio Vista, Modesto, Last Chance and Josephine. They are on the north side of Ord Mountain, on steep slopes which often terminate in precipitous cliffs at the top of the spurs.

The principal rock exposures are an ancient andesitic flow and monzonite. The andesite lies in a north-south belt from 2000 to 3000 feet wide. On both the east and west sides it is in contact with the monzonite. A series of roughly parallel veins occur in the andesite. The strike of these veins varies from about N. 15° E. to N. 15° W., dip 50 to 70° to the east. The wall rock adjacent to the veins is distinctly schistose, evidently from shearing stresses developed where the fissures were made. There are four east-west faults crossing the property which displace the veins from 100 to 400 feet. The width of the veins varies from 4 to 20 feet. The vein filling consists of brecciated wall rock recemented with quartz. The mineralization for approximately 125 feet in depth consists of copper carbonates and free gold. Below this depth, the primary sulphides, chalcopyrite and bornite, carrying gold, are the principal minerals. This belt is traceable, on surface, for a distance of approximately 2½ miles.

Considerable development work, scattered over a period of some thirty years, has been done on the property. The Brilliant shaft was sunk on an inclination of 70°, a distance of 200 feet. On the first level, approximately 100 feet from the surface, there is a drift south 25 feet. On the second level, which is at a depth of 182 feet, there is a drift south 40 feet, also a crosscut from the shaft, east 22 feet, and a

drift from the end of this crosscut about 45 feet south. There is also a drift north from the shaft 45 feet. It is reported that the crosscut is all in ore, averaging $4 in gold and 3 per cent copper, largely in the carbonate form.

On the Belgium claim, at an elevation of 4000 feet, a main haulage tunnel has been started. It is being driven due south. It is intended to continue this tunnel for approximately 6800 feet, which will bring it under the present workings on the Rio Vista, 700 feet below the lower Rio Vista tunnel and 1100 feet below the surface. It is now in 200 feet and it is believed that it will be on the vein for its entire length. There is another tunnel on the Belgium claim, the portal of which is adjacent to the portal of the main haulage tunnel. It was driven in a southwesterly direction, a distance of 480 feet. At 140 feet from the portal, there is a winze 160 feet deep. Further sinking in this winze is now in progress.

On the Josephine claim is a tunnel driven southwesterly a distance of 475 feet. It is reported that this tunnel shows good ore for a width of 18 feet. Some 200 feet southwest of the face of the tunnel there is an 80-foot shaft.

On the Coupon claim there is a crosscut tunnel west 170 feet. At 150 feet from the portal is a drift south 40 feet and 200-foot crosscut west from the face of the drift.

On the Rio Vista there are two tunnels. These are approximately 125 feet (vertically) apart, the upper one being about 300 feet below the top of the mountain. The lower tunnel is a crosscut east 770 feet. At 700 feet from the portal there is a drift south 437 feet and north 110 feet. The upper tunnel is a crosscut east about 250 feet. Drifts have been driven north and south. The south drift is caved at 150 feet from the crosscut and the north drift is now open for only a few feet. Just north of the crosscut is a raise to the surface. Some stoping has been done here in the past but is not now accessible.

Practically all of the drifts are on veins which carry values both in gold and copper. No information regarding real averages are available, although it is reported there is much ore exposed which carries from $3 to $4 and 2 per cent to 3 per cent copper.

Eight men are employed driving haulage tunnel and sinking the winze which is eventually to be a working shaft 1000 feet deep.

Bibl: State Mineralogist's Reports X, p. 528; XII, p. 234; XIII, p. 326; XV, p. 789; Bull. 50, p. 336.

Ozark Mine, also known as The Big Ten. (See under Gold.)

Pacific Mines Corporation. (Bagdad-Chase and Roosevelt Mines.) This property, which is 7 miles south of Ludlow, comprises 17 patented claims, totaling 340 acres. Principal owners, John H. Hobbs and Mrs. Edith George, Glendora, California.

It was operated by the above company, which had its principal office at 120 Broadway, New York City; J. N. Beckley, president; J. H. Hobbs, secretary; Frank W. Royer, of Los Angeles, consulting engineer.

There is a railroad from Ludlow to the mine.

The ore is deposited in an igneous breccia on a contact of monzonite and rhyolite. The brecciated material, which is the result of faulting, consists of both rhyolite and monzonite fragments cemented with a

highly silicious material. The strike of this zone is east and west and it dips 25 to 30 degrees to the north. Its average width is from 8 to 15 feet. It has been proved on the surface along its strike for 2000 feet. The footwall is monzonite with a rhyolite hanging wall. The orebody has been faulted by a series of faults which strike north and south, with displacements varying from 100 to 240 feet.

The ore is principally oxides of copper, some silicates and very finely divided gold. But little sulphide, if any, has been encountered. The gangue is very siliceous and is heavily stained with iron oxides.

When in operation this mine shipped many thousand tons of ore to the Clarkdale, Arizona, smelter. This ore is reported to have carried 0.27 ounces of gold, 5 ounces of silver and 1.5 per cent copper.

Developments consist of vertical shaft 400 feet deep, incline shaft 450 feet on 30 degree incline, also shafts 200 feet, one hundred and forty feet and 120 feet deep, respectively. All of these shafts were sunk on the ore and several thousand feet of drifts and crosscuts were driven from them. Each shaft is equipped with a gasoline hoist. A 16-inch by 14-inch by 10-inch Sullivan, two-stage compressor supplies air for the drills.

Before operations were suspended a small, experimental flotation plant was erected. It is reported that tests in this plant showed a recovery of 90 per cent of the gold, 40 per cent of the silver and 95 per cent of the copper.

It was estimated by various engineers that there is 150,000 tons of available ore yet remaining in the mine, the average copper content being 1.4 per cent to 1.5 per cent and from $7 to $8 gold per ton. It is also reported that there is a possibility of discovering the downward extension of these orebodies some 1500 to 2000 feet north of the present workings. In this case, the ores heretofore worked would represent the faulted portion of the original orebodies, this faulted zone having been moved south from 1500 to 2000 feet. Should this theory prove to be correct, the discovery of a sulphide zone might lead to a long life of productiveness for this mine. Idle.

Bibl: State Mineralogist's Reports XV, p. 790; XVII, pp. 341-342.

Pauper's Dream and Quidunc Group, consisting of one and a fraction claims, is located on the southwest slope of the San Bernardino Mountains. It is in Sec. 4, T. 2 S., R. 1 W., S. B. M., about 5 miles northeast of Yucaipa. Elevation about 3500 feet. Owner, R. L. Brooks, Yucaipa, California.

Quartz vein 6 inches to 12 inches wide, associated with felsite dike in schist. Reported to carry values up to 4 per cent copper and $4 to $12 in gold. Development consists of 30-foot shaft and opencuts.

One man employed on assessment work.

The Piper Group, consisting of 6 claims, is 1½ miles north of Barstow. Elevation 3000 feet.

Quartz vein carrying copper and gold occurs in schist.

The Price Group of 11 claims is located in T. 6 N., R. 2 W., S. B. M., 12 miles east of Victorville. Elevation 4200 feet. Owners, A. C. Price and Milton McNiellan, Long Beach, California.

A 3-foot to 5-foot vein, filled with highly copper-stained barite, occurs in an east-west fracture in limestone; dip 80° to the south. There

are two other veins, associated with epidote dikes in the limestone. They are parallel, strike N. 40° W., dip 75° NE.; width 3 feet and 4 feet, respectively. The vein filling is copper-stained barite.

Development consists of 35-foot shaft on the first vein; opencuts and a crosscut tunnel on the other two. Idle.

Rincon Mines Company has 28 claims in the Monumental Mining District, about 25 miles north of Parker, Arizona. The property is divided into five groups, namely: Rincon Copper Group, 12 claims; The Rincon Placer Group, 2 claims; Hematite Gold Group, 4 claims; Klondike Group, 5 claims; Owl Group, 5 claims.

The Rincon Group millsite and mill are on the banks of the Colorado River. Property is now idle. For further information see

Bibl: State Mineralogist's Report XVIII, pp. 308-309.

Rosalia Mining and Milling Company. (See under Gold.)

Silver Dome Mine. (See under Gold.)

Silver Lake. (See under Silver.)

Sagamore Mine (formerly New York Mine) is on the south slope of the New York Mountains about 10 miles west of Burdy and 6 miles south of Vanderbilt. Elevation 5800 feet. In New York Mining District. Owner, *Ivanpah Copper Company.*

This property, on which considerable work has been done in the past, has been idle for several years.

Bibl: State Mineralogist's Report XV, p. 790; Bull. 50, pp. 331, 332.

Standard Mine is located in the Ivanpah District, 15 miles north of Cima.

Some ore was shipped from this property several years ago but no work has been done in recent years.

Bibl: State Mineralogist's Report XV, p. 790; Bull. 50, p. 330.

Thelma and Mammoth Group in the Goldstone District, 33 miles north of Barstow.

Quartz veins in granite carry values in copper, gold and silver. Development consists of a series of prospect shafts 10 feet to 20 feet deep. Idle.

Three States Mine is in the Silver Lake District, 6 miles west of Silver Lake.

The ore is chalcopyrite which occurs along the contact of dioritic dikes with limestone. Idle.

Bibl: State Mineralogist's Report XV, p. 791.

Tuscarora Mine. It is located 7 miles northeast of Calzona, a station on the Parker cut-off of the Santa Fe Railroad.

The vein is 5 to 10 feet in width, occurring on contact between schist and diorite. The ore is said to average 2.5 per cent copper with $10 to $20 in gold. Development consists of several shafts. Idle.

Bibl: State Mineralogist's Report XV, p. 791.

GOLD

Gold was first discovered in the San Bernardino range of mountains in May, 1860. The total recorded production through the year, 1929, has amounted to $7,894,760. It is the most widely distributed metal of commercial importance in the county.

The auriferous veins of the county may be divided into two chief groups: Those of the San Bernardino range and those of the desert ranges. The veins of the San Bernardino range for the most part, occur on and near the north slope, which rises from the margin of the Mojave Desert.

The principal districts are: Bear Valley, Black Hawk, Holcomb Valley and Morongo.

The chief districts in which the desert veins occur are: Arrowhead, Dale, Goldstone, Gold Reef, Ivanpah, Ord, Oro Grande, Steadman, Twenty-nine Palms and Vanderbilt.

In April, 1926, some excitement resulted from the reported discovery of high-grade gold ores in Kramer Hills. Thousands of people from Los Angeles, San Bernardino and adjacent territory visited the district and hundreds of claims were located. Many shallow shafts were sunk but none of this work resulted in the development of a mine. The only systematic attempt to develop a producer in the district is described in the body of this report under the name of the Shaherald Mining Company.

The district is located in a low range of hills in the southern portion of T. 10 N., R. 6 and 7 W., S. B. M. It is 3 miles south and approximately 6 miles east of Kramer, a station on the Barstow-San Francisco line of Atchison, Topeka and Santa Fe Railroad and about 3 miles east of the road from San Bernardino to Randsburg. The axis of these hills has a general east-west direction. They rise some 400 to 500 feet above the floor of the valley to a maximum elevation of approximately 3000 feet.

The backbone of the range is probably granite, but on the north slope where the gold values are found, there are few exposures, the surface being covered with alluvial deposits. Due to the character of this alluvium, it is thought that the granite which shows on the south side of the hills, is flanked on the north by a wide body of pegmatite. This extends down the north slope to within some 250 feet, vertically, of the floor of the valley. At this point there is a schist belt which traverses the country in an east-west direction for a distance of some two miles. Its width varies from about 100 to 200 feet and it dips at a low angle to the south. In this schist belt, more or less closely associated with narrow dikes of volcanic rocks, are found the gold values. High-grade streaks and pockets have been encountered on the contact of the dikes and schist, while low-grade values seem to be disseminated through the schist, but close observation shows that they are between the laminations of the schist, and in joints which have been developed in the rock. These joints are approximately at right angles to the schistosity and are so close together that samples taken in crosscuts would appear to indicate uniformly distributed values in the rock itself. Such dissemination is present to the depths to which this area has been prospected. The gold is practically all free:

very little sulphide showing in the ore. Vein filling consists of talc, quartz grains and crushed wall rock. Values are also found in a loosely cemented breccia which occurs along the contacts.

It is reported that this district is now being investigated for the purpose of determining whether this deposit may be handled profitably by steam shovel, the ore to be treated in an amalgamation plant.

MINES

Altuma Mine. It is situated 15 miles east of Bear Valley and about 3 miles south of Rose Mine. Elevation, 8000 feet.

Bibl: State Mineralogist's Reports XII, p. 229; XIII, p. 319.

Alvord Mine. It is situated 23 miles northeast of Daggett and 6 miles north of Manix, a station on Union Pacific Railroad. Idle. Owner, Mr. McCormick, Yermo, California.

Bibl: State Mineralogist's Reports VIII, p. 499; XI, p. 359; XIII, p. 319.

Anaconda Mine. It is situated in the Twenty-nine Palms Mining District, about 55 miles northeast of Banning. Elevation 2850 feet. Owner, P. T. Sullivan, Twenty-nine Palms, California. Holdings comprise 4 claims.

Vein occurs in granite, strike N. 40° W., dip 73° E. The vein varies from 8 inches to 2 feet in width. Developments consist of two shafts, 100 feet and 185 feet deep. Production $10,000. Idle.

Bibl: State Mineralogist's Report XVII, pp. 344, 345.

Apex Mine is in the Oro Grande District, about 4 miles north of Oro Grande. It adjoins the Gold King on the west. Owner, Ed Merkle, Victorville, California.

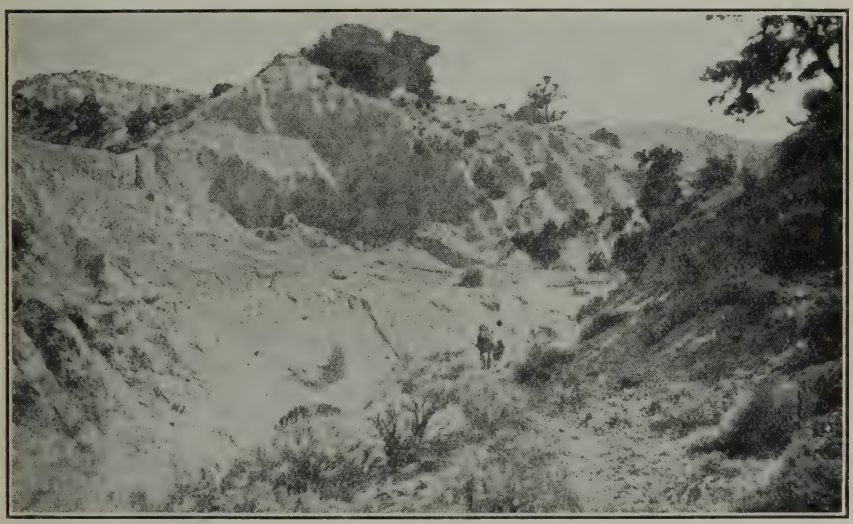
Development consists of 300 feet to 400 feet of tunnels. The portal of tunnel has a door which was locked at the time of visit. Idle.

Arlington Mines (formerly known as *Black Hawk Mines*). This property comprises a group of 47 claims, known as the Black Hawk Group of Mines, situated in Secs. 5, 8, 9, 16 and 17, T. 3 N., R. 2 E., S. B. M., 35 miles southeast of Victorville, on the east slope of the San Bernardino range of mountains. Elevation 4200 feet to 6700 feet. Owner, Arlington Mining Corporation; Algeron Del Mar, president; Roy K. Voorhies, secretary. Offices, 740 South Broadway, Los Angeles. The property has been under active development by this company since 1922.

Geology: The geology of the Blackhawk Canyon area is described in detail by A. O. Woodford and T. F. Harries in a bulletin issued by the Department of Geological Sciences of the University of California, Vol. 17, No. 8. The formations that occur in the vicinity of Blackhawk Canyon are gneissoid granite overlain by white, gray or reddish metamorphic limestone, and a series of interbedded sandstone. The metamorphic limestone is almost pure calcite or pure dolomite or a mixture of the two. Along Blackhawk Canyon the limestone is in the form of a breccia. The brecciated limestone masses that have been exposed by this canyon are a part of the mountain range and stand in cliffs hundreds of feet high.

Ore occurrence: The ore consists of crushed limestone breccia slightly silicified, with red iron streaks running through the brecciated wall that gives it a pinkish or reddish color. The fragments range from one-quarter inch to 6 inches in diameter, the major portion being less than 3 inches. The fragments are slightly cemented together, stained red, being principally calcite, with some dolomite, and a few irregular grains of quartz. The footwall of the ore zone is granite with a hanging wall made up of massive limestone. The Black Hawk lode which follows along Blackhawk Canyon strikes N. 20° E. and dips 5° to 20° to the S.W. This lode has been developed principally on the Cliff, Black Hawk and Senator Group of Claims.

The Arlington-Santa Fe lode strikes N. 80° E. and dips 5° to 20° SW. The crushed zone is at least 30 feet thick, with a gneiss footwall and a limestone hanging wall. In the Santa Fe Mine near the top



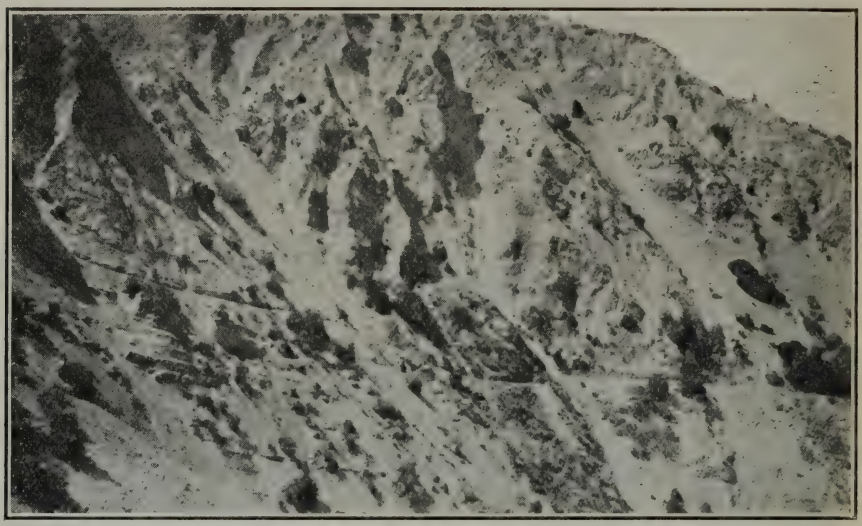
Opencut on Black Hawk lode. Blackhawk Canyon, San Bernardino County. Arlington Mining Corporation.

of the crushed zone, the ore occurs as a dark red gouge which varies from 2 to 6 feet in thickness.

The gold occurs in the soft material that forms the filling between the crushed fragments and not in the coarse pieces of hard rock. The richest ore is found in the hematite streaks that occur at intervals throughout the crushed zone. The major portion of the gold values is concentrated in the fine materials. The ore is free-milling, oxidized gold ore.

Orebodies: At the extreme end of Blackhawk Canyon, at an elevation of 6100 feet, occur the orebodies of the Santa Fe-Arlington group. The lode is 4500 feet in length. The thickness of the orebody varies from 30 to 100 feet. The principal development work consists of 4 tunnels, from which about 2000 feet of crosscuts and drifts have been driven. Besides this development there are nine tunnels varying in length from 20 to 250 feet.

Estimated tonnage on Santa Fe-Arlington Group: East End Santa Fe: Orebody 110 feet thick, containing 550,000 tons, is said to have an average value of $2.30 per ton in gold. West End Santa Fe: In this area there are a series of five or more parallel veins, one of which is known as 'Calle de Oro Vein,' has been developed by tunnel and incline winze to a depth of 300 feet from surface. The ore extracted from



Black Hawk lode 70 feet thick. Cliff Mine in Blackhawk Canyon. Arlington Mining Corporation.

this development work, about 2000 tons is reported to have had an average value of $11 per ton in gold. On the fourth level this vein has a width of 12 feet. On the fifth level, the vein varies from 20 to 40 feet wide. About 20,000 tons of ore have been developed having an average value of $5 per ton. It is estimated that on the Santa Fe Claim the amount of probable ore developed amounts to about 600,000 tons, having an average value of $3 per ton.

Cliff Mine area: The Cliff Mine which is located in Blackhawk Canyon has been developed by over 1200 feet of tunnel and raises, which have exposed a shattered orebody 75 feet thick. It is stated that on this claim there has been developed 350,000 tons of ore that has an average value of $1.75 per ton in gold. Overlying the Cliff orebody, there is 300 feet of shattered blue limestone that is stated will average 85 cents per ton in gold. Taking this deposit as a mass of ore, it is estimated that there is a probable tonnage of 14,000,000 tons with an average value of $1.20 per ton in gold.

Besides the areas referred to, there has been exposed by erosion and shallow prospect shafts and tunnels on other claims of the group, a potential tonnage of ore of commercial grade that will probably run into several million tons.

Proposed method of treatment: It has been determined by actual mill operations and numerous mill tests made on ore extracted from the Cliff and Santa Fe mines that the best method of treatment is as follows:

The crude ore as mined is screened through trommel screens to ¼-mesh. The plus ¼-mesh rejected goes to dump, while the minus ¼-mesh is transported by aerial bucket tram to mill. The screen ratio is 4 tons into one ton. Mill tests on ore from Santa Fe Mine show the average value of the minus ¼-mesh material or screenings to be $6.50 per ton. The reject material carries 90 cents per ton.

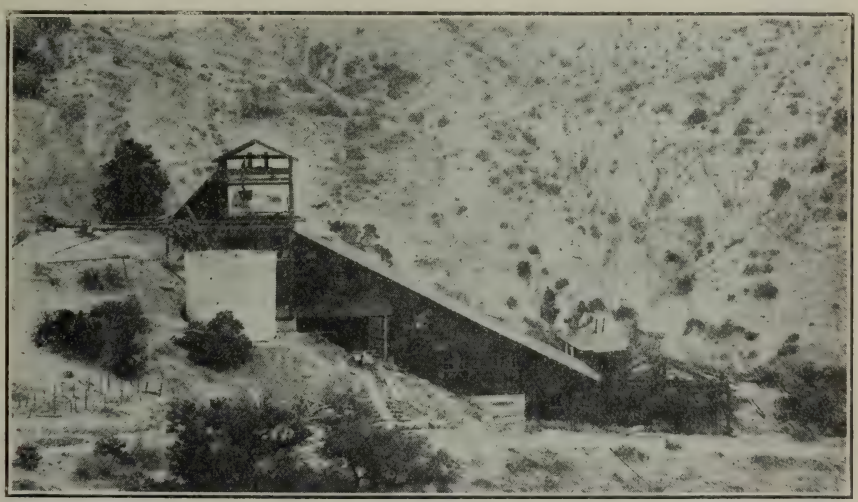
Treatment consisted of grinding in Hardinge mill to 30-mesh; amalgamation on plates, and cyanide treatment by counter-current-air agitation. The recovery by amalgamation was 68 per cent and with cyanide treatment was 91 per cent. Total tonnage treated is reported to have been 3170 tons.

Mill tests on ore from Cliff Mine: Screen ratio, 3.6 tons into one ton of ¼-mesh, reject 30 cents per ton. Average crude value of ore before screening was $1.70 per ton. Screenings carried $4.40 per ton. Cyanide treatment on this ore indicated a recovery of 86 to 91 per cent of gold values.

The property has certain economic features that make it possible to treat the large tonnage of low-grade ore that has been exposed by Blackhawk Canyon for a distance of two miles by cheap mining and milling methods.

There is sufficient water on the property to operate a mill with a capacity of 200 tons. An additional water supply can be secured from Arrastra Creek, about 4½ miles from the property.

Electric power can be secured from the Southern Sierras Power Company's line, which runs within 6 miles of the property. It is stated that



Twenty-five-ton amalgamation and cyanide plant. Arlington Mining Corporation. Blackhawk Canyon, San Bernardino County.

the total cost of mining and milling, based on treating 300 tons per day, are as follows:

Mining, overhead and depreciation	$0 30
Screening	05
Milling	40
Total cost per ton of ore	$0 75

Mine equipment consists of tugger hoist, compressor and air drills. Mill equipment consists of one two-bucket aerial tram from Cliff workings, 557 feet in length. Capacity of buckets 12 cu. ft.; also ¼-inch trommel. Bunkers and aerial bucket tram from Santa Fe Mine to the mill. The mill has a capacity of 25 tons per day. Equipment consists of Hardinge mill; Dorr duplex classifier; amalgamation plates; Dorr thickener and two Plato tables; and cyanide plant. The mill is driven by one 37½-h.p. Y type Fairbanks-Morse semi-diesel gas engine; a 25-h.p. Fairbanks-Morse horizontal semi-deisel engine drives generator that furnishes electric power for operating motor that drives compressor at the Santa Fe Mine. Six men are employed.

Bibl: State Mineralogist's Reports IX, p. 226; X, p. 524; XI, p. 364; XII, p. 230; XIII, p. 330; XV, pp. 797–798.

Armistice Claim (formerly the *Pathfinder*) is in T. 5 N., R. 2 W., S. B. M., about 15 miles east of Victorville. Owner, A. C. Watson and W. T. Elliot, Hesperia, California

Quartz vein in granite. Strike N. 60° W., dip 58° to the south. Vein varies from 4 to 6 feet; quartz from a few inches to 2 feet. There is an 85-foot incline shaft on the property. Idle.

Bagdad-Chase Mine. (See under Copper. Pacific Mines Co.)

Bald Eagle Mining Company has 2 claims in the San Bernardino Mountains, 1½ miles northeast of Yucaipa. They are in Sec. 31, T. 2 S., R. 1 W., S. B. M. T. Tally, Yucaipa, California, is president of the company.

Stringers of quartz and clay gouge occur on each side of a felsitic dike in granitic gneiss. The dike has a width of 4 to 6 feet. Strike N. 65° E., dip 65° to the north. The quartz stringers vary in width to a maximum of 12 inches and are reported to carry some gold.

Development consists of 70-foot tunnel and 25-foot winze. A small cyanide plant was erected.

Barrett Mine (Hamerback and Patterson Group of Mines). The property comprises 10 claims located 12 miles southeast of Cima, on the east slope of the Providence range of mountains. Elevation 5400 feet. Owner, *California-American Mining Company*; Dr. Orman Lutz, president; J. E. Miller, secretary.

The vein occurs in granite; strike north and south, dip 70° E. The width varies from 14 inches to 3 feet. The orebodies are in the form of lenses of quartz along the fissure. The vein quartz is mineralized with galena, pyrite and chalcopyrite said to carry from $6 to $25 per ton in gold. Development consists of three shafts. The main shaft has been sunk on the vein to a depth of 320 feet. There are two other shafts on the vein to a depth of 100 feet. Drifts have been driven on the vein on 50-foot, 100-foot, 200-foot and 300-foot levels. On the 100-foot level there is a drift south 450 feet, north 65 feet; on the 200-foot level, a drift north 65 feet and south 240 feet. On the 300-foot level there is a drift south 65 feet and north 65 feet. It is reported that 35,000 tons of ore have been developed above the 300-foot level. Idle.

Bibl: State Mineralogist's Report XV, p. 816.

Belmont Mine. It is located in the Goldstone Mining District, 34 miles northeast of Barstow. Elevation 3300 feet. Owner, Belmont Mining Company; Dr. W. W. Ramsey, president; George I. Drumm, secretary. Offices, Stockton, California. Holdings comprise 21 claims, totaling 420 acres.

The present development work is confined to the Belmont group, consisting of 5 claims.

Two parallel quartz veins occur in shales and schist, strike N. 60° W., dip 25° to the northeast. The veins vary in width from 12 inches to 3 feet. The ore is free-milling, with some pyrite.

Development consists of a number of shafts sunk to depths of 50 to 300 feet on the different veins. The main shaft is 400 feet deep, sunk on an incline of 35 degrees. Between 100 and 160 feet below the collar of the shaft the vein has been faulted by strike fault. On the 160-foot level there is a drift west on the vein for a distance of 50 feet. On the 230-foot level the vein has been drifted on 160 feet west. On the 330-foot level there is a drift west 50 feet. The ore extracted from these workings is reported to carry from $8 to $25 per ton in gold. Some high-grade ore was shipped from the property during 1916 and 1917.

Mine equipment consists of 25-h.p. gas-driven hoist, 7½-inch by 6-inch Chicago pneumatic compressor; air drills; blacksmith shop and cars. Mill equipment consists of 25-ton ball mill and amalgamation plates. Idle.

Bibl: State Mineralogist's Report XX, pp. 46–47.

Big Horn Group, consisting of 3 claims, is located in the Granite Hills, 16 miles east of Victorville. Owners, Wm. Walsh, Ray Wilson, D. W. Smith and W. T. Elliott, Hesperia, California.

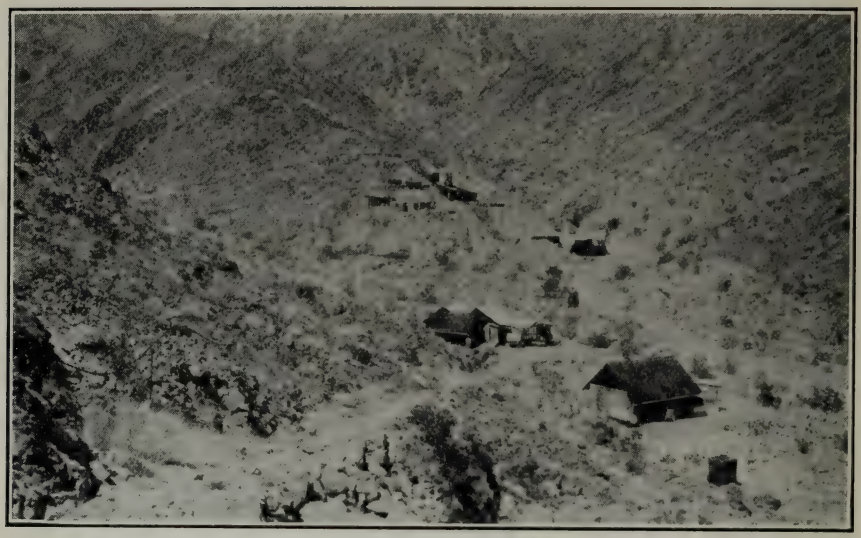
Quartz vein accompanies a diorite dike in granite. The strike is NW., dip vertical. A 40-foot vertical shaft is the only development. Reported values of $16 in gold per ton. Idle.

Brooklyn and Los Angeles Mines. It comprises a group of 15 claims located in the Dale Mining District, 45 miles northeast of Mecca, and 30 miles south of Amboy, a station on the Santa Fe Railroad. Elevation 2000 feet. Owner, *Campbell Gold Lease Company*; John L. Campbell, president; Dewey M. Campbell, secretary. Offices, Fuller Building, San Bernardino, California.

The country rock is granodiorite with intrusions of diorite and diabase dikes. There is a series of five parallel veins that occur in the granodiorite, which are about 1000 feet apart. The most important veins are known as the Brooklyn and Los Angeles veins, and therefore most of the development work is confined to these two veins. The veins strike northwest and southeast and dip 70° to the northeast. These veins vary in width from 2 to 6 feet. The vein quartz is stained with iron and copper oxides.

Development consists of 17 shafts, with depths ranging from 25 to 750 feet deep. The total underground development amounts to 8500 feet.

Brooklyn vein: The total length along the vein is 4500 feet. Development: A tunnel has been driven on the vein northwest 550 feet about



Brooklyn Mine and Camp. Dale District, San Bernardino County.

Three-stamp mill on Los Angeles Group. Dale Mining District, San Bernardino County.

100 feet below the vein outcrop. At 300 feet northwest of portal, a winze has been sunk on the vein to a depth of 200 feet. No. 1 level is 120 feet below tunnel level, and on this level the vein has been drifted on southeast 300 feet, connecting with a shaft 100 feet deep sunk from the surface, at a point near portal of tunnel. Northwest of winze there is a drift 75 feet to fault. The fault strikes N. 40° E., and dips 85° SE., and has displaced the vein 75 feet to the northeast. No ore was found beyond this fault on the different levels.

No. 2 level, at 110 feet below tunnel level, drifts 170 feet southeast and 170 feet northwest.

No. 3 level, at 160 feet below tunnel level, 245 feet of drifts on the vein.

No. 4 level, at 200 feet below tunnel level, 75 feet of drift on the vein. It is estimated that there is 4000 tons of ore developed that has an average value of $16 per ton, with 1 to 3 ounces in silver per ton. Two ore shoots were developed and stoped, one was 100 feet in length and the other 200 feet in length, with an average width of 4 feet.

There are about 5000 tons of tailings below the mill that, it is stated, will average $7 per ton in gold. The total production of the Brooklyn Mine is reported to be $150,000. The vein was discovered in 1893 and operated by the *Brooklyn Mining Company* from 1901 to 1916.

Los Angeles Group: It comprises 4 claims, with 4500 feet on the lode. On Los Angeles No. 3 claim, a shaft has been sunk on the vein to a depth of 750 feet, and 540 feet northwest of this shaft there is a shaft 250 feet deep that connects with No. 2 level of the main shaft.

On 52-foot level drift NW. 725 feet; 120-foot level drift NW. 365 feet; 320-foot level drift NW. 225 feet; 420-foot level drift NW. 175 feet; 685-foot level drift NW. 658 feet.

Only a small amount of stoping has been done above 120-foot level and considerable ore is exposed on the 52-foot and 120-foot levels. The estimated ore reserves in the Los Angeles Group are about 50,000 tons, with an average value of $9 per ton in gold. Below mill there is 2000 tons of tailings, said to have an average value of $6 per ton in gold.

Equipment: On Brooklyn group of claims there are three 750-pound stamps with 30-ton rod mill. On Los Angeles group of claims there is a mill with three 250-pound stamps. Idle.

Bibl: State Mineralogist's Report XV, p. 802.

Calmont Mine consisting of 11 claims is 19 miles southeast of Amboy. Owner, G. M. Benjamin, Amboy, California.

The property was worked in 1927 by the Calmont Mining Company. George Parks, Frank Tilton and Del Page, of Barstow, California, were connected with this operation.

This mine was not visited but it is reported that a heavily iron-stained quartz vein, in granite, averages 2½ feet in width. Strike E.-W., dip about 70° to the south.

Development consists of 200-foot shaft, sunk on the vein with drifts of about 100 feet each on the 100-foot and 200-foot levels. It is also reported that the gold values in the vein exposed in these workings will average about $15 per ton. There are two other parallel veins on

the property, one of which is reported to be larger and stronger than the one on which the work has been done.

Idle, except for assessment work.

Camp Castle Mine (formerly the *Great Gold Belt Mine*) comprises 5 claims in the Bristol Mountains, 14 miles northeast of Amboy. Owner, E. M. Streeter, 1505 Hope street, South Pasadena, California.

This property probably was worked by Indians many years ago, remains of old arrastras having been found in the wash. It was rediscovered in 1907 and the Great Gold Belt Mining Company did some work on it at that time. It was relocated by the present owners about 1923.

The country rock consists of rhyolite, andesite, diorite and granite. The mountain to the southwest is capped with volcanic tuff which is several hundred feet in thickness. Several veins cross the property. The strikes vary from N. 40° E. to N. 65° E., dip from 70° SE. to vertical.

The principal vein, which is traceable on the surface for about 2200 feet, strike N. 65° E., dip 70° S., has an average width of about 2 feet, varying from a few inches to 5 feet. Its north wall is dolomite, the south wall is diorite. This vein appears to be faulted in perhaps two places. The fault is along a northwest-southwest line, with a displacement of some 25 feet.

Two incline shafts, each 275 feet deep, were sunk on this vein. It is reported that these two shafts intersect at the bottom. They are also connected on the 100-foot level. It is reported that there is some drifting on the 200-foot level and that the average width of the vein in these workings is 2 feet. Massive sulphide ore shows on the dump. These workings were inacessible (filled with water) at the time of visit.

Present work is being done at a point about 250 feet northeast of these shafts. Here a shaft is being put down; present depth is 25 feet. The vein as here exposed shows 2 feet of quartz, one foot of talc and schistose country rock, and 1½ feet of quartz, the full width showing mineralization with the free gold content being confined to the quartz. General samples from this work are reported to run from $4 to $18, with a general average of $12.

In the gulch several hundred feet southeasterly from these workings, much surface work has been done. Also two shafts about 70 feet deep have been connected and about 200 feet of drifting was done here. It is reported that many high grade samples were taken from these workings.

Water has been developed by means of a 35-foot shaft and a 60-foot crosscut on the southeastern portion of the property. Also the old workings are under water from the 100-foot level down.

A small jaw crusher and a 3-foot Herman ball mill (no plates) are now on the property, together with a 15-h. p. Fairbanks-Morse semi-diesel engine; 2 small pumps with gas engines to operate them. Idle.

Camp Rock Placer Mine, consisting of 3 lode claims and 9 placer claims, is in Sec. 28, T. 7 N., R. 3 E., in the Bessemer Mountains, 25 miles northeast of Box S Ranch and 47 miles (by road) from Victorville. Owner, Charles Pohl and Henry C. Stock, of Los Angeles.

These claims lie on the detrital slope at the foot of the Bessemer Mountains, on the southwest side. At this point the mountains consist

almost entirely of granite. The drainage is to the southwest into a valley which also receives drainage from the southwest slope of the Ord Mountains. A narrow drainage channel on this slope has been prospected for about 1000 feet of its length. The work consisted of shallow pits and open cuts. The gravel removed was treated by dry washers and in the following plant:

Material delivered by trucks to pockets, with grizzly, elevated to trommel; thence to bin and sluice box about 50 feet long.

Bedrock, where exposed, is from 15 to 25 feet below the surface. A well sunk to a depth of 210 feet on the property is reported to yield 6 gallons of water per minute. Idle.

Christie Mine. It is situated near the Rose Mine, in T. 2 N., R. 3 E., 40 miles southeast of Victorville, in the Black Hawk Mining District. Idle.

Bibl: State Mineralogist's Reports XII, p. 231; XV, p. 796.

Clipper Mountain Mine. It is situated in the Gold Reef Mining District, about 5 miles northwest of Danby. Holdings comprise 8 claims. Owner, Clipper Mountain Gold Mining Company; B. G. Doak, president; A. H. Hayes, secretary. Offices, I. W. Hellman Building, Los Angeles.

The vein is 10 to 80 feet wide, strikes northwest and southeast, dip 60° SW. The footwall is rhyolite, with andesite as the hanging wall. The ore occurs as free gold in quartz-calcite veins.

Development consists of vertical shaft 300 feet deep. Operations were suspended in 1920 due to encountering a heavy flow of water on the 300-foot level. Idle.

Bibl: State Mineralogist's Report XVII, p. 345.

Colosseum Mine. It comprises 58 unpatented claims and 2 patented claims known as Colosseum No. 1 and Colosseum No. 2, located in the north end of the Clark Mountains, in T. 17 N., R. 13 E., S. B. M., 12 miles west of Calada, a station on the Union Pacific Railroad, and 10 miles north of Valley Wells. Elevation 5500 to 6100 feet. Owner, Colosseum Mines, Inc.; C. H. Gowman, president; Earl Thomas, secretary. Offices, 401 Bank of Hollywood Building, Hollywood, California.

The formations in the vicinity of the Colosseum Mine are made up largely of granite and of dolomitic limestone. The mine lies in the granite, which has been classified as monzonite, and the ore deposit occurs in an intrusive eruptive quartz-porphyry that has come up through the monzonite. About one-half a mile west of the mine is the contact of the dolomite and monzonite. The contact between the dolomite and the monzonite is marked by beds of shale and quartzite and shows no evidence of contact metamorphism. The orebody has evidently been formed by mineralization within a zone of fracturing occurring in the intrusive quartz-porphyry. The quartz-porphyry is mineralized with pyrite and and marcasite, carrying gold. The ore occurs along the joint planes and fracture planes. The orebody strikes N. 60° E., and dips 80° SW., and is in the form of a chimney or a longitudinally shortened lens, and it is shown to be continuous in grade and character for a vertical distance of about 200 feet.

Developments consist of a tunnel located on the east slope of the hill, at an elevation of 6000 feet, driven N. 25° W., 800 feet. At 120 feet from portal, cut first ore which shows a thickness of 50 feet. At 225 feet north of portal, a drift has been driven N. 60° E., a distance of 80 feet and 90 feet to the southwest, exposing 100 feet of ore. Two orebodies have been developed on this tunnel, one being 50 feet wide and 100 feet in length, one 60 feet wide by 125 feet in length. A shaft has been sunk to a vertical depth of 200 feet, with levels at 100 and 200 feet. Crosscuts have been driven north on the 100 and 200-foot levels, 350 feet, with drifts to southwest in the orebody.

The ore developed in tunnel and shaft is said to have an average value of $7 per ton in gold, with occasional mineralized areas carrying as high as $30 per ton in gold. 26.7 tons of ore mined from tunnel level and shipped to the United States Smelting, Refining and Mining Company, carried 0.73 ounces gold, 1.1 ounces silver, 0.2 per cent copper, with gross value of $14 per ton. Shipment of 39.6 tons carried 0.44 ounces gold, 0.85 ounces silver, 0.1 per cent copper, with gross value of $8.46 per ton. Ore reserves 50,000 tons having an average value of $7 per ton.

Present development is confined to driving a tunnel, at an elevation of 5800 feet, which will connect with the bottom of the vertical shaft; the distance to be driven is 550 feet.

Water is secured from shaft of the old Mojave Tungsten Mine, now owned by the company.

Mine equipment consists of duplex Deming (5-inch by 6-inch) pump driven by 25-h.p gas engine; cement reservoir, capacity 60,000 gallons; cement reservoir at mine, capacity 35,000 gallons; one 180-h.p. Fairbanks-Morse diesel engine; 3-cycle water-cooling tower; one 210-cu. ft. Gardner-Denver compressor; one 115-cu. ft. Gardner-Denver compressor.

Mill equipment consists of 50-ton ball mill; Wilfley tables; and Simpson flotation machines. Fifteen men employed.

Bibl: State Mineralogist's Report XX, pp. 92-93.

Coolgardie Placer Mines, comprise a group of 4 claims, located at Coolgardie, in Sec. 29, T. 32 S., R. 46 E., 15 miles north of Barstow. Owner, Ira Foreman, Torrance, California.

These placers have been worked at intervals since 1900 by dry washers and concentrators. The Coolgardie placers are reported to have had a production of $100,000 to date.

Bibl: State Mineralogist's Report XV, p. 817.

Columbia Mine. (See under Copper.)

Darling Mine. It comprises a group of 20 claims located in the Vanderbilt Mining District, 4 miles east of Ivanpah, a station on the Union Pacific Railroad. Elevation 5000 feet. Owner, Chas. C. Darling, Ivanpah, California.

There are two vein systems on this property, one being a series of north and south veins, the other being a series of east and west veins. The veins of both series are roughly parallel. The formation is granite. The veins vary in width from 3 to 6 feet.

Developments: On the Midnight claim, a shaft has been sunk on an incline of 60° to a depth of 266 feet. The vein strikes north and south and dips 60° W. The vein has a width of 3 feet. At a depth of 90 feet encountered sulphide ore. The vein quartz is mineralized with pyrite and stated to carry values of $10 to $20 per ton in gold. Drifts have been driven on the vein on the 65- and 165-foot levels. On the 65-foot level there is a drift north 30 feet and south 225 feet. On the 165-foot level there is a drift north 125 feet and south 125 feet. About 700 feet north of this shaft on the Crystal claim, there is a shaft 165 feet deep, with drifts on the 50 and 80-foot levels. This shaft is sunk near the intersection of a north and south and east and west vein. The Midnight and Crystal veins, which strike north and south, are roughly parallel and about 50 feet apart.

Mine equipment consists of 2-drill Sullivan compressor; 12-h.p. single-drum hoist; and Sullivan tugger hoist. Idle.

Desert Gold Placers. It comprises a group of 115 placer claims, located on Desert Lake, 6 miles east of Ivanpah and 10 miles south of Roach, a station on the Union Pacific Railroad. Owner, Desert Gold Dredging Company; H. P. Ewell, president; George W. Cram, secretary. Offices, 415 Union Oil Building, Los Angeles.

Gold occurs in unconsolidated sands and gravel of the dry lake bed. It is reported that pay gravel has been proved to a depth of 3 to 6 feet by test holes. The gravel is reported to carry 20 cents per cubic yard in gold. Idle.

Bibl: State Mineralogist's Report XVII, p 345.

Elkhorn Mining Company (property formerly known first as *Golden Era,* then the *Silver Basin*), consisting of the following claims: Golden Era, Hidden Treasure, Ransome, O'Farrell, Fraction, Mondan Fraction and Y. W. Fraction, a total of 60 acres, located in Sec. 7, T. 30 S., R. 41 E., M. D. M., 2½ miles southeast of Randsburg. Elevation 3600 feet. Owner, *Silver Basin Mining Company;* A. J. Rubenstein, president; Bradley Benson, secretary-treasurer, 462 South Spring street, Los Angeles.

Two parallel quartz veins occur in the schist, strike NW., dipping 70° NE. Width is 12 inches to 3 feet. There is also a series of north-south fractures which appear to be stronger than the northwest-southeast fissures. These have widths up to 5 or 6 feet and are filled with brecciated wall rock, partially cemented with quartz.

Development: There is a 240-foot shaft on the Hidden Treasure claim. Present work is confined to the Golden Era, where the shaft was sunk to 100 feet and 750 feet of drifts and crosscuts were driven; also a raise was put up about 60 feet to tap a small stope from which 17 tons of ore was milled in the Black Hawk mill, returning $17 per ton on the plates. It is reported that this shaft is now being sunk and that a vein, carrying high-grade tungsten ore on one wall and rich gold ore on the other, has been encountered.

Equipment consists of blacksmith shop; head frame; Sullivan air compressor, driven by 40-h.p motor; and 50-h.p. motor driving hoist. Seven men employed.

Bibl: State Mineralogist's Report XIX, p. 169.

Embody Mine. It is situated one-half mile east of Oro Grande. Idle.

Bibl: State Mineralogist's Reports XI, p. 361; XV, pp. 812, 813.

Emerson Mine. It comprises a group of 10 claims located in the Dry Lake Mining District, 50 miles east of Victorville. Owner, Mrs. L. S. Emerson, Hodge, California.

A series of parallel veins in granite; strike NW. and SE.; dip 70° SW. The veins vary in width from 2 to 4 feet.

Development consists of a shaft 400 feet deep. Idle.

Equitibus Mine. It comprises a group of 8 claims, situated on the west slope of the Providence range of mountains, in the Kelso Mining District, 3½ miles east of Hayden, a station on the Union Pacific Railroad. Elevation 3300 feet. Owner, Equitabus Mining Corporation; John W. Baily, president; Patrick Cline, secretary; Joe Filmore, superintendent. Offices, Las Vegas, Nevada.

A series of parallel veins occur in granite, the veins being from 50 to 150 feet apart. The veins strike N. 50° E. and dip from 60° to 80° to the southwest. The veins vary in width from 12 inches to 4 feet. The vein quartz is mineralized with galena and pyrite, with gold and silver values. Three parallel, andesitic porphyry dikes, having a general north and south strike, occur in the granite, being about 1000 feet apart. The quartz veins cut through the dikes and show only slight displacement.

Development consists of five shafts and one tunnel on the different veins. The shafts are from 30 to 200 feet in depth, and one tunnel 100 feet in length. The principal development work is confined to No. 2 vein. On this vein an incline shaft has been sunk to a depth of 200 feet. Drifts have been driven on the vein on the 70, 150 and 200-foot levels. On the 150-foot level there is a drift southwest 200 feet. On the 200-foot level there is a drift to the northeast 230 feet. The vein exposed in these workings varies from 6 inches to 2 feet in width. The ore occurs in a series of short lenses of quartz along the fissure and passes from one wall to the other. About 800 feet southeast of this shaft there is a shaft 80 feet deep, sunk on an incline of 80 degrees. The vein exposed in this shaft is from 2 to 4 inches in width, the vein quartz being mineralized with galena and pyrite. About 50 feet to the north of this shaft is a parallel vein of quartz upon which no development work has been done. The vein quartz is stated to carry from $8 to $20 per ton in gold and silver, with 3 to 12 per cent lead.

Mine equipment consists of 15-h.p. Novo single-drum gasoline hoist; 110-cu. ft. portable Rix compressor; and 2 Cochise jackhammers.

Eight men are employed.

Evan Davis Mine. It comprises 4 claims, located 50 miles east of Victorville. Elevation 5000 feet. Owner, Glenn A. Davis, Victorville, California. Idle.

Bibl: State Mineralogist's Report XV, p 815.

Exchequer Mine. It comprises 5 claims, situated in the Dale Mining District, 4 miles south of Dale and 20 miles east of Twenty-nine Palms. Elevation 2000 feet. Owners, John McGrath and Al McRae, San Bernardino, California.

Development work consists of three shafts 40 to 110 feet deep. Idle.

Bibl: State Mineralogist's Report XV, p. 803.

Fremont Peak Mine is situated on the western slope of Fremont Peak, at an elevation of 3700 feet. Holdings consist of 12 claims, in T. 31 S., R. 41 E., S. B. M., 18 miles southeast of Randsburg. Owner, L. A. Mason, Oakland, California.

A series of parallel quartz veins occur in granite and also on the contact of granite and rhyolite-porphyry dikes. The veins have a general east and west course, dip 70° N., widths varying from 12 inches to 2 feet.

Development consists of an incline shaft 100 feet deep with levels at 50 and 100 feet. On the 50-foot level there is a drift west 125 feet and 100 feet east. Two tunnels have been driven on a parallel vein that occurs along a rhyolite dike. These tunnels are 100 and 200 feet in length. The average width of the veins is 12 inches and they are said to carry $25 per ton in gold. Idle.

Bibl: State Mineralogist's Report XIX, p. 172.

Frisco Group of Mines. It comprises a group of 5 claims located in the Kelso Mining district on the west slope of the Providence range of mountains, 7 miles east of Hayden, a station on the Union Pacific Railroad. Elevation 5000 to 5200 feet. Owner, Pete Thibdeau, Kelso, California.

These claims join the Providence Mine on the north and east. The formation is diorite and dolomitic limestone. The gold quartz veins occur in the diorite. There is a prominent rhyolitic-porphyry dike that strikes north and south. The dike is from 20 to 50 feet wide and can be followed for several miles along its outcrop. There is a series of parallel east and west veins that intersect this dike from the east. These veins are from 12 inches to 2 feet wide, with a high-grade streak on one wall.

On Frisco Claim No. 3, one ton of ore extracted from Short tunnel on one of these east to west veins and shipped to U. S. Smelting, Refining and Mining Company, carried 2.17 ounces in gold, and 55.4 ounces in silver.

Development consists of a number of tunnels from 20 to 400 feet in length and shafts from 20 to 100 feet in depth. The principal development, however, is confined to Frisco No. 5 and Frisco No. 1 claims. On Frisco No. 5 claim, the vein strikes east and west and dips 60° south. Width of vein is 8 feet. A shaft is sunk on this vein to a depth of 100 feet. The vein quartz is mineralized with pyrite and galena and carries values in gold and silver.

On Frisco Claim No. 1, which is located 1 mile north of Providence shaft, at an elevation of 4800 feet, a tunnel has been driven southwest 400 feet; at 300 feet southwest of portal it intersects rhyolitic-porphyry dike. It is stated that samples cut across 35 feet of this dike carried $3 per ton in gold. At 200 feet from the portals a raise was put up to the surface on a cross-fracture, a distance of 50 feet. At 300 feet from portal, a winze was sunk to a depth of 30 feet, exposing 8 feet of sulphide ore said to have an average value of $15 per ton in gold. The vein quartz is heavily mineralized with iron pyrite. Idle.

Globe Mine. It comprises 7 claims located in the Kelso Mining District, on the west slope of the Providence range of mountains, 7 miles east of Hayden, a station on the Union Pacific Railroad. Elevation 5300 feet. Owner, Globe Gold Mining Company; George H. Thomas, president; A. C. Jones, secretary, Los Angeles.

The vein strikes east and west and dips 65° south. The vein varies in width from 4 to 8 feet.

Development consists of a tunnel 1000 feet in length. The vein quartz is mineralized with galena and pyrite, carrying values in gold and silver. Some very high-grade ore has been shipped from the property. Idle.

Gold Bar. (See Vanderbilt Mines.)

Gold Belt Mine (formerly the *McGinnis* or *Gold Peak Mine*). This property embraces 9 claims on the southwest slope of Goat Mountain, 30 miles slightly north of east from Victorville. Elevation 4500 feet. Owner, Gold Belt Mining Company; C. W. LaFountaine, president and manager; J. Davis, vice president, South Gate, California.

The country rock is granitic, largely monzonite and diorite. A fissure vein, varying from 2½ to 7 feet wide, filled largely with quartz and calcite and in places, having a rhyolitic casing on the hanging-wall side, strikes N. 40° E., dips 45° SE. This vein is traceable on the surface for about one-half mile. Mineralization consisting of free gold, pyrite and some chalcopyrite was observed in the ore on the shaft dump.

Development consists of an old vertical shaft 200 feet deep, with levels at the 50-foot, 100-foot and 200-foot horizons. On the 50-foot level there is a drift 50 feet southwest and 100 feet northeast, with a winze which is approximately 50 feet deep in the northeast drift.

One hundred-foot level: Drift about 50 feet southwest and 40 feet northeast.

Two hundred-foot level: Drift 75 feet southwest and 230 feet northeast, with a 25-foot winze in the northeast drift.

The vein shows strong and of good average width to this depth and is reported to carry good values.

About 1000 feet to 1200 feet southwest of this shaft and about 500 feet below its collar, a tunnel is being driven on the vein, N. 40° E. At the time of visit (December, 1929) this tunnel had a length of something over 300 feet. It was being driven to pick up the ore shoot below the bottom of the old shaft and to prospect the ground between.

Equipment consists of compressor driven by semi-diesel oil engine. It was reported in May, 1930, that a mill is being erected at this property.

Seven men employed on two shifts, driving the tunnels.

Gold Bronze Mine. It comprises 7 claims located in the Vanderbilt Mining District, adjoining the Vanderbilt Mines on the east, 4 miles east of Ivanpah, a station on the Union Pacific Railroad. Elevation 5200 feet. Owner, C. A. Bell, Ivanpah, California.

Two parallel veins occur in the granite, strike east and west and dip 70° N. The veins have an average width of 6 feet. The vein quartz is heavily mineralized with pyrite. The Gold Bronze shaft was sunk on the most northerly vein to a depth of 300 feet. The sulphide ore

was encountered on the 100-foot level. The ore mined and milled, was mostly oxidized gold ore.

About 200 feet south of the Gold Bronze shaft, a shaft was sunk on a parallel vein to a depth of 200 feet. The ore mined is stated to have an average value of $20 per ton in gold. Idle.

Bibl: State Mineralogist's Reports XI, p. 367; XII, p. 232.

Gold Bullion Mine, consisting of one claim, is in the Oro Grande Mining District, about 4 miles northeast of Oro Grande. It adjoins the Ozark on the south. Elevation about 3500 feet. Owner, J. F. Tedford, Oro Grande, California. Under lease to S. B. Hunnewell, on the property.

Quartz vein in andesite, strike N. 10° W., dip 60° W. The andesite is in the form of a dike about 60 feet wide. Where the main vein occurs the andesite is schistose from shearing stresses. Numerous cross stringers intersect this vein which is about 18 inches to 2½ feet wide.

Development consists of a vertical shaft 80 feet deep. This is partially caved. Present operator is cleaning it out to investigate report that there is 30 inches of $70 ore in the bottom.

Two men are employed.

Gold King is in the Oro Grande Mining District, about 5 miles northeast of Oro Grande. It consists of 7 claims on which considerable tunnel work has been done. Owner, George Comas and associates, Hotel Haskell, Eighth andd Wall streets, Los Angeles. Idle.

Gold King Mine. It is situated in the Gold Valley Mining District, about 16 miles south of Cima and 23 miles northwest of Fenner, on the east slope of the Providence range of mountains. Elevation 5000 feet. Owner, Gold King Mining Company; Burr H. Robbins, president, South Pasadena, California.

Development consists of a shaft 400 feet deep. Mill equipment consists of 25-ton rod mill with amalgamation plates and tables. Two men employed.

Gold Mountain Mine. This mine is situated in the San Bernardino range of mountains, north of Baldwin Lake in the Bear Valley Mining District. Elevation 7350 feet. Owner, James Hulmes, South Pasadena, California. Holdings comprise 16 claims, totaling 320 acres.

The vein system occurs as irregular bodies of massive quartz containing free gold. The strike of the orebody is N. 60° W., dip 30° to 60° south. The average width of the vein is 40 feet.

Development consists of a glory hole approximately 600 feet long by 40 feet wide and by 50 feet deep. An adit tunnel 700 feet long has been driven N. 60° W., 85 feet vertically below the outcrop. The ore mined from the glory hole is said to have an average value of $4 per ton in gold. There is a 35-stamp mill on the property. Idle.

Bibl: State Mineralogist's Report XVII, pp. 346–347; XII, p. 232; XIII, p. 322.

Gold Reef Mines. Situated in Gold Reef Mining District, on the southeast slope of Clipper Mountain, 6 miles northwest of Danby, a station on the Santa Fe Railroad. Elevation 2700 feet. Owner, Gold Reef Mining Company, 600 I. W. Hellman Building, Los Angeles.

Ore occurs in a highly silicious rhyolite dike, strike northwest and southeast, dip 60° SW.

Developments consist of two shafts 100 and 500 feet in depth. Formerly operated under lease and bond by the Tom Reed Mining Company, of Oatman, Arizona, in 1917–1918, but operations were suspended due to striking a heavy flow of water on the 500-foot level. Idle.

Bibl: State Mineralogist's Report, p. 346.

Gold Rose Mine. It comprises 15 claims situated in the Dale Mining District, adjoining the Los Angeles Group of Mines on the southwest, 45 miles northeast of Mecca, a station on the Southern Pacific Railroad. Elevation 1700 feet. Owner, Thomas Holmes, San Bernardino, California.

Four parallel veins occur in the granite. The veins strike northwest and southeast and dip 70° NE. The veins vary in width from 2 to 6 feet.

The development consists of five shafts sunk on the different veins that are from 25 to 250 feet in depth. Gold Rose No. 2 shaft is 235 feet deep sunk on an incline of 70°. Gold Rose No. 1 shaft is 100 feet in depth with drift on the vein on the 100-foot level for a distance of 200 feet. On Gold Rose Claim No. 4, a shaft has been sunk on a vein on an incline of 70°, with a drift south on the 100-foot level, a distance of 110 feet. From this level, a winze has been sunk on the vein to a depth of 30 feet. The vein has an average width of 4 feet. The vein quartz is mineralized with galena and stained with copper carbonates.

The ore mined is said to carry from $12 to $15 per ton in gold. Bunches of galena occur at intervals along the vein. Sorted lead ore is stated to carry 20 to 30 per cent lead, with gold and silver values. Equipment consists of 6-h. p. gas engine hoist.

Gold Eagle Mine. It comprises 5 claims located 2 miles east of Burns Springs, and 20 miles north of Whitewater, in the Morongo Mining District. Owner, R. B. Brown, Los Angeles.

The vein occurs in the granite, strikes north and south, dip 60° E. Average width of vein is 12 inches, said to have an average value of $15 per ton in gold. The occurrence of bismuth sulphide was noted in the quartz. Idle.

Goldstone Mine. It is situated in Goldstone Mining District, 33 miles northeast of Barstow, a station on the Santa Fe Railroad. Elevation 3600 feet. Owners, Goldstone Mining and Milling Company; J. M. Schofield, president; G. Marston Leonard, secretary, Boston, Massachusetts. Holdings of the company consist of 22 claims, totaling 440 acres.

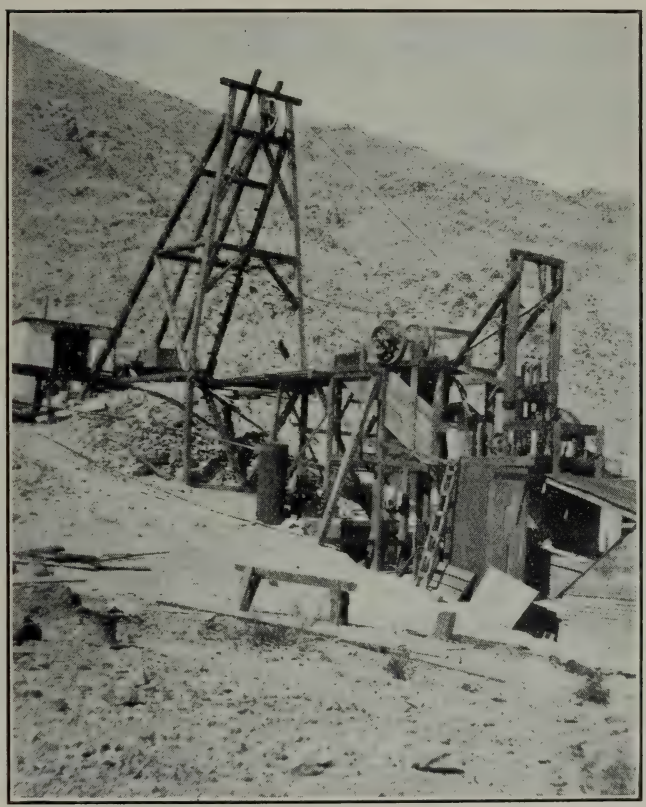
A quartz vein occurs on the contact of limestone and shale. The vein has a course of north and south to northwest and southeast, and dips 40° E. Average width of vein is 4 feet.

Development consists of vertical shaft 300 feet deep. At a depth of 50 feet the shaft cuts through the vein, the remaining distance being in the limestone footwall. What ore was mined was extracted from open cut on the vein, which is 150 feet long. The ore from these workings is said to have averaged $40 per ton.

Equipment consists of 25-h.p. gas engine hoist, and a 12-inch by 12-inch Fairbanks-Morse compressor driven by 50-h.p. gas engine. Idle.

Bibl: State Mineralogist's Report XV, pp. 805–806; XX, p. 47.

Grand View Mine. It comprises 31 claims located on the southeast slope of Ord Mountain, in Secs. 9, 10 and 15, T. 6 N., R. 2 E., S. B. M., 18 miles northeast of Box S Ranch and 42 miles northeast of Victorville. Elevation 4100 feet. Owners, *Garvan Mining and Reduction*



Shaft and three-stamp mill. Grand View Mine, Ord Mountains, San Bernardino County.

Company, Ltd.; R. E. Garrison, president; W. G. Van Horn, secretary, Victorville, California.

A series of parallel veins which strike N. 30° E. and dip 65° NW. occur in andesitic porphyry. The main development work has been confined to the Grand View vein, which has been exposed on the surface for a distance of 3000 feet along its outcrop. The vein has a maximum width of 15 feet, with an average width of 8 feet. The footwall of the vein is a granitic porphyry with an andesite hanging wall. The vein filling is brecciated rhyolitic-porphyry, highly silicified, iron stained with hematite, carrying free gold.

Development consists of a 2-compartment shaft sunk to a depth of 100 feet on an incline of 65°. At 38 feet below the collar of the shaft, the vein has been drifted on 70 feet. There is also a level at 98 feet from the collar of the shaft, with 75 feet of drifts.

The ore milled from these workings is said to have had an average value of $8.90 per ton in gold.

Both north and south of the Grand View shaft are some intrusive rhyolite dikes which strike north and south. East of the shaft there is an intrusive diabase dike that probably faults the vein north of the shaft.

Considerable development work has been done on the other veins, with open cuts and short tunnels. It is stated that samples taken from these veins carry from $10 to $20 per ton in gold.

Mine equipment consists of 6-h. p. Fairbanks-Morse gas engine hoist. Mill equipment consists of three 1000-pound stamps driven by 15-h. p. gas engine; blacksmith shop. Three men employed.

Gypsy Queen Mine. It comprises 6 claims situated in the Dale Mining District, 15 miles southwest of Twenty-nine Palms. Elevation 1800 feet. Owners, James McCain and F. T. Moore, Twenty-nine Palms, California.

The vein strikes north and south, dips 70° W.; width 4 feet, with 2 feet of oxidized quartz on the footwall. The formation is granite.

Developments consist of a number of shafts from 50 to 100 feet in depth, with a number of shallow open cuts and short tunnels. The principal development work consists of a shaft sunk on the vein to a depth of 125 feet, with levels at 50 and 100 feet and several hundred feet of drifts.

Mine equipment consists of 6-h. p. gasoline hoist. Idle.

Hello Al Group, comprising 12 claims, is 5 miles northeast of Oro Grande. Owners, A. R. Greenslitt, J. F. Tedford and J. L. Sterne, Oro Grande, California.

There are two parallel veins in rhyolite, about 80 feet apart. Strike E.-W., dip 35° S.; average width about 18 inches with 24 inches maximum. Vein filling consists of quartz and silicified wall rock which gradually shades into the unaltered country rock. These veins are traceable for a few hundred feet, disappearing under surface debris.

Development consists of an inclined shaft about 100 feet deep. It was inaccessible at time of visit. Reported to show 12-inch vein in bottom which carries $20 in gold per ton. Idle.

Hidden Hill Mines. This group of mines is situated in the Arrow Mining District, on the eastern slope of the Providence range of mountains, 20 miles west of Fenner, a station on the Santa Fe Railroad. Owner, Claypole and associates, of Needles, Arizona.

A series of parallel veins occur in a granitic-porphyry, which is brecciated along these fractures. The veins are narrow, varying in width from 1 to 12 inches. The quartz contains jasper with high gold values. The veins strike N. 30° E., and dip 45° W. These veins are displaced by a number of north and south faults.

Development consists of an incline shaft 240 feet deep and a crosscut tunnel. This property has been noted for the high-grade ore pockets that have been extracted from the veins. During 1913, one

pocket extracted amounted to 300 pounds, producing $13,000. One man employed.

Bibl: State Mineralogist's Report XVII, p. 348.

Holcomb Valley Placers. These gold placers are situated in Holcomb Valley, in the San Bernardino range of mountains, in T. 3 N., R. 1 W., S. B. M., 25 miles southeast of Victorville and 9 miles west of Doble. Elevation 7000 feet. Owners, H. J. Potter, San Bernardino, California, and W. E. Esplin, Los Angeles.

During 1917 the property was under operation by the Holcomb Valley Dredging Corporation, of Los Angeles. A number of test holes were put down on the property and a shaft on the property was unwatered and sampled.

The gold deposits of Holcomb Valley are a primary concentration from the erosion of the schist and porphyrys of the Gold Mountain region. It is a broad porphyry belt which crosses the country in a northwesterly and southeasterly direction, and can be traced for several miles. This belt is apparently full of numerous quartz stringers and pocket seams. In places the country rock for considerable widths will run three or four dollars per ton in gold. It is from the erosion of this belt that the Holcomb Valley placers are formed.

During the late eighties and early nineties, these placers were worked by an English company by means of steam shovels and elevators. Most of this work was done along the edges of the deposit. It is stated that the material handled by this operation averaged 30 cents per cubic yard. There is an area of about 400 acres on Holcomb Creek, which varies in depth from ten to fifty feet, that may offer a possibility for dredging operations. The only water available is that from Holcomb Creek, which has a flow of thirty to forty inches. Idle.

Bibl: State Mineralogist's Reports X, pp. 520-523; XII, p. 233; XIII, p. 323; XV, pp. 798-799; XVII, p. 349; Bull. N92, p. 154.

Ivanhoe Mine. It comprises 13 claims, situated in the Dale Mining District, on the east slope of the Dale Hills, 2½ miles east of New Dale, and 22 miles east of Twenty-nine Palms. Elevation 3000 feet. Owner, Denny B. Pardo, San Bernardino, California.

Three parallel veins known as Top Nest, Hidden Treasure and Ivanhoe, occur in andesitic porphyry. The veins are approximately 600 feet apart, the Ivanhoe being the most easterly vein. The veins strike N. 20° W. and dip 80° E., to vertical. Widths of veins vary from 2 to 6 feet. The vein quartz is stained with copper oxides and shows considerable hematite and some free gold, with chalcopyrite and bornite. The average value of the ore is reported to be $15 per ton in gold, with selected ore carrying $36 per ton in gold.

The principal development is confined to the Ivanhoe vein. On this vein a shaft has been sunk to a depth of 215 feet, with levels at 70 feet, 125 feet and 200 feet. On the 700-foot level there is a drift north 300 feet. On the 125-foot level there is a drift north 325 feet; on 200-foot level, a drift north 40 feet and south 50 feet. About 200 feet north of this shaft, there is a raise from the 70-foot level to the surface. A small amount of stoping has been done on the 70-foot level

and the ore mined is said to have plated $16 per ton in gold. On the north end of the Ivanhoe vein there are two shafts about 200 feet apart, that are 90 feet in depth. On the Hidden Treasure vein there is a shaft 90 feet deep and a tunnel 100 feet in length. On the Top Nest vein, on the slope of the ridge north of Ivanhoe Canyon, there are four tunnels driven at different elevations, from 100 to 200 feet in length. The average width of the vein exposed in these workings is 2 feet.

Mine equipment consists of 15-h.p. gas-engine hoist. Mill equipment consists of 25-ton dry concentration plant. Idle.

Jim Boy Group of Claims. There are 7 claims in this group, situated in the Dale Mining District, about one-half mile southwest of the Supply Mine and 15 miles east of Twenty-nine Palms. Elevation 2200 feet. Owners, Everett Corthers and C. E. Cusick Estate, Dale, California.

The vein occurs in diorite, striks N. 40° W., dip 70° NE.; width 12 inches to 3 feet,

Development consists of a shaft 40 feet deep and two tunnels, one 100 feet in length, the other 50 feet in length. One man employed.

Johnson's Mine. It is situated 18 miles east of Box S Ranch, and 4 miles south of Ord Mountain, on the east slope of a low range of hills. Owner, R. A. Johnson, Victorville, California.

A quartz vein accompanies a diorite dike in gneissoid granite; strike north and south, and steep dip to the west. The vein varies from 12 inches to 4 feet in width; of this width from 4 to 10 inches is iron-stained quartz. The remaining portion consists of brecciated wall rock, recemented with quartz. The entire width is mineralized with pyrite. The quartz carries free gold.

Development consists of a crosscut tunnel driven west 300 feet to intersect the vein. Drifts have been driven 140 feet south and 240 feet north on the vein. The maximum depth attained below the outcrop is 100 feet.

Equipment consists of 15-h.p. Fairbanks-Morse gas engine which drives a 2-drill compressor. One man employed.

June Group of Claims. These claims are situated in the Dale Mining District, 16 miles east of Twenty-nine Palms. Elevation 1800 feet. Owners, Cooper Bros., Twenty-nine Palms, California.

The claims adjoin the Gypsy Queen Group and are on the same vein system.

Development consists of shallow shafts and opencuts. Idle.

Keystone Mine. It comprises 3 claims situated 18 miles northeast of Victorville, near the Sidewinder Mine. Owners, J. T. Vetter, P. C. Markley and C. M. Richards, of Los Angeles.

Lester Mine comprises 11 claims situated on the north slope of the San Bernardino Mountains, about 4 miles east of Blackhawk Canyon, extending westerly from Arrastra Creek about 2 miles and about 40 miles southeast of Victorville. Elevation 4300 feet. Owners, D. J. Wheeler and W. F. Dall, San Bernardino, California.

On the east end of the property there is a quartz vein, strike N. 45° W., dip vertical. The northeast wall is a gneissoid granite and the

southwest wall is granite. There is also a cross-vein, the strike of which is northeast. This, apparently, intersects the main vein about 200 feet northwest of a shallow shaft. Beyond this intersection, the vein traverses the country for probably a mile. In some places the vein is in limestone and then on the contact of the gneissoid granite and the limestone.

Development consists of a shaft 25 feet deep, and at a lower elevation a tunnel is being driven on the vein. The present length of the tunnel is 50 feet. Three men employed.

Lost Burro Mine. It comprises 7 claims located in Gold Valley, 16 miles south of Cima, a station on the Union Pacific Railroad. Elevation 5000 feet. Owner, Lee Strawn, Cima, California.

Vein strikes north and south and dips 37° W. The vein has an average width of 3 feet with 6-inch streak of high-grade ore on hanging wall. Average grade of ore is $25 per ton in gold.

Development consists of an incline shaft 125 feet deep. Idle.

Mabel, Contention and Investment Group of Mines, comprises 12 claims located in the Arrow Mining District, 23 miles northwest of Fenner, on the eastern slope of the Providence range of mountains. Elevation 3750 feet. Owner, *Western Development Company* of Los Angeles.

The formation is composed principally of granite, diorite, quartzite and porphyry. A series of parallel, intrusive dikes of porphyry occur in the quartz-monzonite. The dikes have a general north and south trend. The quartz veins occur on both walls of these intrusive dikes. The veins vary in width from a few inches to 4 feet. The veins have a N. 20° E. strike, dip 40 to 75° W. There are also a number of veins which have an east and west strike and dip south, the most notable being the Contention and Big Ledge veins. The latter is 10 to 12 feet wide. The ores are siliceous in character and contain values in gold, silver and copper, the principal value being gold. The ore is reported to carry from $6 to $80 per ton in gold. The production is reported to have been about $100,000, all of which was shipped to the smelters. Only ore exceeding $50 per ton was shipped. Oxidized zone extends to a depth of 100 feet.

Developments: The Contention shaft, sunk on east and west vein to a depth of 230 feet, with levels at 65 feet, 100 feet, 144 feet and 200 feet. Mabel shaft, 140 feet deep, sunk on north and south vein. Sulphide ore was encountered at a depth of 120 feet. The Mabel vein has a width of 12 feet with a 12-inch streak on footwall that is said to carry from $25 to $100 per ton in gold. It is stated that samples taken for the full width of the vein had an average value of $9 per ton in gold. There are a number of other shafts sunk on the different veins to depths of 50 to 100 feet. Idle.

Bibl: State Mineralogist's Reports XV, p. 801; XVII, p. 349; XX, pp. 196–198.

Massen Group of Claims, comprises 87 claims, located on the northwest slope of Alvord range of mountains, in Secs. 26–35, T. 12 N., R. 3 E., 32 miles northeast of Barstow. Elevation 2400 to 3100 feet. Owner, J. H. Massen and associates of Los Angeles.

A number of parallel, narrow quartz veins occur in the granite. These veins have a general course of northwest and southeast, with dips varying from 40 to 60° to southwest. The veins vary in width from 2 inches to 2 feet.

Developments consist of a number of shallow shafts and short tunnels. Idle.

Bibl: State Mineralogist's Report XX, pp. 47–48.

Morning Star Mine. It comprises a group of 18 claims, situated in Secs. 27, 28, 33 and 34, T. 15 N., R. 14 E., S. B. M., on the east slope of the Ivanpah range of mountains, in Mescal Mining District, 8 miles north of Cima. Elevation 4400 feet. Owners, J. B. Mighton and H. T. Brown, Cima, California.

The vein occurs as a rhyolitic-porphyry intrusive in quartz-diorite, which strikes north and south and dips 34 degrees west. The width of this porphyry dike is about 350 feet. The vein material is highly silicified and the mineralization occurs along a series of more or less parallel east and west fractures in the dike itself. The ore is quartz, heavily mineralized with pyrite, of which it is stated 20 to 40 per cent of the values are in free gold, the remaining values being in the pyrite. The values vary from $3 to $15 per ton. Samples taken by different engineers across a width of 280 feet are said to have an average value of $4.37 per ton in gold.

Development consists of a tunnel driven 600 feet along the footwall of the dike, which is 350 feet vertically below the outcrop. At a point 185 feet north of the portal, No 1 crosscut is driven west 96 feet. Channel samples cut at 5-foot intervals in this crosscut, it is stated, carried an average value of $4 per ton in gold. At 450 feet north of portal of the tunnel, No. 2 crosscut is driven west 285 feet. From this point the course of the tunnel is changed to N. 20° W. and is in the vein-dike for the remaining distance of 150 feet. At 550 feet north of portal, No. 3 crosscut is driven east 40 feet to the footwall. About 30 feet north of this crosscut, a winze has been sunk to a depth of 50 feet below the tunnel level and at this depth the winze encounters the footwall. The ore extracted in sinking this winze is reported to have an average value of $15 per ton in gold. Estimated tonnage of ore above tunnel level is said to be 2,000,000 tons with an average value of $4.37 per ton in gold. About one mile south of the Morning Star tunnel, on the Kewanee Claim, there is an outcrop of quartz 20 to 50 feet wide, strike north and south, dip 34° W. A shaft has been sunk to a depth of 125 feet on a 65° incline.

Equipment consists of Gardner-Denver compressor driven by Lozier automobile engine. Air drills and blacksmith shop. Two men employed.

Morongo King Mine. It comprises 3 claims situated in the Morongo Mining District, in T. 2 N., R. 5 and 6 E., S. B. M., 46 miles north of Seven Palms, a station on the Southern Pacific Railroad. Elevation 5000 to 6000 feet. Owner, Morongo King Mining Company, San Bernardino, California.

The vein strikes northeast and southwest and dips 65°; width of vein 4 feet. The vein quartz carries a large percentage of pyrite, with some free gold.

Development consists of shaft 180 feet deep, with drifts on 100-foot level. Idle.

Bibl: State Mineralogist's Reports VIII, p. 504; IX, p. 266; X, p. 526; XII, p. 234; XIII, p. 324; XV, p. 800.

Mountain King Group is in the northwest end of the Turtle Mountains, 10 miles north of Salt Marsh, a station on the Parker cut-off of The Atchison, Topeka and Santa Fe Railroad. It comprises 7 claims. Owners, Thomas Schofield, Amboy, California, and A. L. Doran, Barstow, California.

It is reported that a brown, porphyritic dike in schist, from 300 feet to 400 feet wide, is mineralized across its full width. Quartz veins and stringers cut this dike, the strike of which is NW.-SE., and dip about 65° to the northeast. Average values across the full width are not known, but samples across 6 and 16 feet are reported to have assayed $40 and $5.40, respectively.

Development consists of an incline shaft 100 feet deep and a tunnel 100 feet long, together with open cuts. Average width of quartz vein in shaft is reported as 20 inches and average value $20 per ton.

There is no water on the property, but there is a well four miles distant.

This property was not visited, the above information having been furnished by Mr. Schofield. Idle except for assessment work.

Murray Mining Company has leased 8 claims (the old *Henshaw Mine*) from the Holcomb Bros. and Phoebe Henshaw. This property is on the north slope of the San Bernardino Mountains in the Silver Creek District, 27 miles (by road) southeast of Victorville. Elevation 4300 feet. Murray Mining Company; Whitham Murray, president, 502 Security Title Insurance Building, Los Angeles.

A crosscut driven south in the face of the mountain, a distance of 300 feet cuts a series of narrow shale beds, alternating with granitic dikes. The sedimentaries are crushed and broken, forming an incoherent mass. A few feet from the face of this crosscut, a drift has been driven east about 15 feet and west the same distance, along one of these contacts. At the base of the east drift, a raise about 100 feet high has been driven to the surface. It is reported that this broken material, for a width of 30 feet at the contact, carries gold values. Pannings of a general sample taken at this point failed to show any gold.

Excavations for a mill were being made just below the portal of this tunnel at the time of visit. Four men employed building the mill.

Myrick Mine. It comprises 7 claims situated 40 miles east of Johannesburg. Owner, F. M. Myrick, Johannesburg, California.

A vein of quartz strikes northwest and southeast, reported to carry $30 per ton.

Development consists of shallow prospect shafts and open cuts. Idle.

Bibl: State Mineralogist's Report XIX, p. 63.

Nichols Mine. It is situated in the Morongo Mining District, 46 miles north of Seven Palms, a station on the Southern Pacific Railroad. Elevation 5500 feet.

The vein is 12 feet wide, strike northeast and southwest. Development consists of four shafts, from 20 to 100 feet in depth. Idle.

Bibl: State Mineralogist's Report XV, p. 800.

North Star and Big Blue Group of Mines. These claims are in the Big Bear Valley Mining District, 45 miles east of Victorville. Owner, Al Watts, Victorville, California.

A vein 2 feet wide occurs on contact of limestone and mica schist; strike east and west; dip 45° N. It adjoins the Rose Mine. Development consists of 300-foot tunnel driven on vein. Idle.

Bibl: State Mineralogist's Report XVII, p. 350.

O. K. Mine. It comprises 5 patented claims located in T. 1 S., R. 12 E., S. B. M., situated in the Dale Mining District, 20 miles east of Twenty-nine Palms. Elevation 2350 feet. Owner, Seeley Mudd Estate and Philip Wiseman, of Los Angeles.

The vein strikes N. 20° E., dips 70° and occurs on contact of andesitic-porphyry and quartz-monzonite, the latter being the footwall of the vein. The vein varies in width from 2 to 6 feet. The vein quartz is iron-stained, and carries some free gold.

Development consists of 2-compartment incline shaft sunk to a depth of 800 feet. Considerable drifting has been done on the vein from the different levels. It is stated that the average grade of ore mined and milled was $9 per ton in gold. There is a 10-stamp mill on the property, weight of stamps being 1000 pounds per stamp. The reported production of the property is over $200,000. Idle.

Olympus Mine (Paradise). This property is situated on the south slope of the Paradise range of mountains, at an elevation of 2300 feet, 22 miles north of Daggett. Holdings comprise 7 claims. Owner, Olympus Gold Mining Company; S. E. Bagley, president; M. W. H. Williams, secretary, San Bernardino, California.

A series of parallel veins occur in granite, strike N. 30° W., dip 33° NE. Width of veins vary from 6 to 20 feet.

The principal development work has been confined to the Klondike vein. There is an incline shaft sunk on the vein to a depth of 400 feet. At the elevation of this shaft, a tunnel has been driven north 400 feet on the vein. The vein in this tunnel has an average width of 6 feet of quartz, and in places there are lenses of quartz 20 feet in width. About 50 feet vertically above this tunnel, there is a tunnel 300 feet in length on the same vein; the lower tunnel is connected with this tunnel by a series of raises. At 365 feet from the portal of the lower tunnel, the vein is cut off by a fault which strikes N. 45° E. It is reported that 50,000 tons of ore has been developed above the lower tunnel that will average $6 per ton in gold. A lower tunnel 400 feet in length connects with shaft on 400-foot level. Only a small amount of drifting has been done on the vein from the levels in the shaft. On 135-foot level there is a drift 100 feet on the vein; on 235-foot level, drift south 50 feet. The mine is supplied with water from Paradise Springs, a distance of 2½ miles.

Equipment consists of 25-h.p. gasoline hoist; 9-inch by 8-inch Ingersoll-Rand compressor. Ten stamp mill driven by 40-h.p. gas engine and one Gibson mill. Idle.

Bibl: State Mineralogist's Report XVII, p. 350.

Ord Belt Mine consisting of 9 claims is in Secs. 4 and 10, T. 6 N., R. 2 E., on the southwest slope of the Ord Mountain, about 21 miles east of Box S Ranch. Elevation approximately 5100 feet. Owner, W. A. Raymond, 2209 Carmona avenue, Los Angeles.

The rocks exposed on the property consist of monzonite, rhyolite, rhyolite-tuff, andesite and dacite. The rhyolite occurs both as capping and in dikes. There are two systems of veins. The north-south veins occur in the dacite, or largely so, while the northeast-southwest veins occur at the contact of the rhyolite with the monzonite. The veins vary in width from a few inches to four or five feet. The vein filling consists of quartz from 3 inches to 2 feet wide and from 3 feet to 5 feet of brecciated wall rock, cemented with quartz. Values all in gold, both free and in the sulphides.

Development consists of a tunnel driven S. 40° W. about 300 feet. The last 50 feet bears N. 50° W. and in the face has intercepted a 12-inch mineralized streak in dacite; strike N.-S., dip 80° E. and is quite heavily mineralized with iron sulphide. About 50 feet from the face is a raise which apparently went up about 30 feet on a north-south vein, which is about 5 feet wide; 15 inches of quartz and about 4 feet of brecciated wall rocks, all carrying sulphides.

Some 700 feet northwest of this tunnel another tunnel has been driven S. 45° W., 160 feet on a contact of rhyolite and monzonite. This contact is marked by brecciation and clayey gouge, having a width of about 2 feet and is reported to be ore. On this same contact, approximately 300 feet northeast, across a canyon, another tunnel, has been driven northeasterly for 80 feet. About 800 feet east and slightly north from this work, a crosscut tunnel has been driven west 460 feet. The portal of this tunnel is about 200 feet lower than the above described workings. This crosscut was driven to intersect the 'contact vein' at depth. It is reported that the face is still 150 feet from its objective. The tunnel started in a surface rhyolite flow, passed through it in 90 feet into dacite. Strike of the contact is northeast-southwest, dips flatly to the west. It is reported that material on this contact for a width of several feet carries values. No idea of the average values on this property could be formed from available information.

The property was formerly under lease to Ord Belt Mining Company; Claude LeFountaine, president, 2721 Laurel place, South Gate, California. They planned to erect 20-stamp mill, part of which was moved onto the ground but was never erected. Idle except for assessment work.

Oro Grande Gold Mines Company, Geo. Anderson, president; I. H. Anderson, secretary and treasurer, Oro Grande, California. The property consists of 7 claims in the town of Oro Grande, just east of the Atchison, Topeka and Santa Fe Railway line.

The principal vein on this property is in a quartzose, micaceous schist, strike S. 15° E., dip 70° W. A series of narrow northeast-southwest fractures intersect the main fissure. The vein filling is silicified schist, in places consisting entirely of quartz up to 6 feet in width. Just south of the present workings the vein is on the contact of schist, with a dark gray, felsitic rock here having a width of about 4 feet and reported to carry values.

The principal development consists of an open cut about 200 feet long, its depth varying from nothing to 20 feet. In the face, the silicified zone shows a width of 12 feet. In the floor of this open cut there is a shaft, reported to be 120 feet deep. This was inaccessible at the time of visit. It is reported by the operator that all of the material from the open cut was milled in a 10-stamp mill, now on the property, and that it returned $4.50 per ton on the plates. About 200 feet southeast of the face of the open cut, a 30-foot shaft has been sunk on the vein at the contact. It is reported that values were encountered in this shaft.

Idle except for assessment work.

Bibl: State Mineralogist's Reports IX, p. 227; XIII, p. 326; XV, p. 814.

Ophir Mine. The property consists of 4 claims, located 6 miles northeast of Oro Grande. Owners, *Rentchler Mines Company,* Los Angeles; Harvey G. Wolff, president; C. A. DeCoo, secretary.

Development consists of three shafts from 185 to 300 feet in depth.

Bibl: State Mineralogist's Report XIX, p. 173.

Oro Fino Mine. This property is situated in the Silver Mountain District, 10 miles southeast of Victorville. Elevation 3790 feet.

The vein strikes east and west and the country rock is felspathic granite. The vein is from 6 inches to 2 feet wide and carries high values in gold. Idle.

Bibl: State Mineralogist's Reports IX, p. 228; XV, p. 815.

Ozark Mine, consisting of 5 claims, is 9 miles northeast of Victorville and about 5 miles from Oro Grande. Elevation approximately 4000 feet. Owners W. S. and R. E. Garrison, Victorville, California.

The formations exposed on this property consist of rhyolite, quartz porphyry and diorite. The quartz porphyry, which is approximately 100 feet wide, is traversed by a series of stringers, strike N. 35° E. with a vertical dip. The filling in these stringers is talc, quartz and altered wall rock. They appear to follow the natural joints in this rock. The cross joints also are filled with talc and quartz and the two systems form numerous intersections, which, it is reported, are mineralized for the full width of the formation. To a depth of about 60 feet the gold is free; below this point sulphides are encountered. The greatest width of a single stringer observed was 6 inches. It is reported that the quartz in this vein carries $60 per ton.

Development work consists of a vertical shaft 100 feet deep, with levels at 50 and 90 feet, respectively. On the 50-ft. level a drift has been driven southwesterly for some 60 feet. This work was done on two parallel stringers, separated by about one foot of altered wall rock, the whole forming a vein some 2 feet wide, which, it is reported, carries good milling values. Other development work consists of open cuts and shallow holes, one of which it is said yielded some high-grade ore. This pit is in the rhyolite 300 feet southwest of the shaft.

The deposit is essentially a stockwork and should be prospected by a series of crosscuts at a depth of about 100 feet to determine the extent and value of the mineralization. Idle. For early history and further details see,

Bibl: State Mineralogist's Report XV, pp. 813–814.

Painsville Claim was one of the original locations in the Ord Mountain District. This claim, which is patented, is on the west slope of Ord Mountain, 14 miles south of Daggett. It adjoins the Ord Mountain or Osborn Group on the south. Elevation 4500 feet. Owners, I. D. Garringer and J. C. MacMillan, both of Los Angeles.

The ore-bearing zone on the Rio Vista Claim of the Osborn Group also traverses this property. The Rio Vista vein, strike N. 20° W., dip 70° E., occurs in the andesite. This andesite is in contact with monzonite on the west. The dip of the contact, where exposed, is 45° to the west. The actual vein, probably varying from 6 to 10 feet in width, occupies a fissure in the andesite, the mineralization, in places, apparently having penetrated the walls for several feet on each side of the fissure. The vein filling consists of quartz and brecciated wall rock, recemented with quartz. Shearing stresses in the vicinity of the veins have produced a schistose structure.

The south half of this property is traversed by a prominent quartz outcrop, strike N. 20° E., dip undetermined. Apparently this vein would form a junction with the Rio Vista about 250 feet south of the 90-foot shaft. This junction, if it exists, is covered by the talus on the mountain side. This is a massive quartz outcrop, in places showing a width of 15 feet or even 20 feet. The east wall is monzonite, which is gneissoid near the vein. The west wall is gneissoid to schistose.

The mineralization of the Rio Vista vein consists of gold and the oxidized ores of copper. Presumably, the quartz vein carries only gold values. No idea of the value per ton has yet been formed.

Development consists of an open cut at the top of a 90-foot shaft about 400 feet south of the north end line. This shaft was inaccessible at the time of visit. The open cut shows a wide zone of silicification and vein about 6 feet in width. The free gold values occur in the broken material on each side of some 3 feet of quartz.

Idle except for assessment work.

Bibl: State Mineralogist's Reports X, p. 528; XV, pp. 808–809.

Piute Mountain Mine. It comprises a group of 10 claims located on the west slope of Piute Mountain, 6 miles southeast of Fenner. Elevation 2800 feet. Owner, Henry Mulheisen and associates, Fenner, California.

The vein occurs in gneissoid granite and consists of a series of lenses of quartz about 20 feet in length and about 4 feet wide, along a fissure at intervals. The strike is northeast and southwest and dip 70° northwest. These lenses of quartz can be followed for a distance of about 500 feet along the outcrop.

Developments consist of a number of open cuts on the different lenses of quartz that are exposed on the surface. The quartz shows free gold, and in 1927 considerable excitement was caused by the discovery of very high-grade gold rock. This caused the location of a great many claims in the district, but the excitement soon died out, due to the fact that no extent of commercial ore was developed. Idle.

Red Bridge Mine. It comprises a group of 9 claims, situated in the Goldstone Mining District, 33 miles north of Barstow. Elevation 3500 feet. Owners, W. B. Redfield and T. L. Henderson, Barstow, California. The claims adjoin the Goldstone Mining Company's group.

Some shipments of high-grade ore were made from the property in 1916, average value being $200 per ton.

Bibl: State Mineralogist's Report XV, pp. 804–807.

Rex and Valencia Hill Group of Mines. It comprises 5 claims, situated in the Holcomb Valley District, 42 miles east of Victorville. Elevation 7500 feet. Owner, *Rex Mining Company*; R. H. Gilman, president, Los Angeles.

The formation is granite, through which intrude large deposits of quartzite, with irregular masses of quartz occurring thoughout the quartzite.

On the Rex claim, the quartzite is well defined and outcrops boldly for 1000 feet, having an average width of 250 feet. Free gold occurs in the quartz along fractures. The mass is reported to carry $4 per ton in gold.

Development consists of an incline shaft 100 feet deep and some shallow shafts and open cuts along the outcrop of the vein. Idle.

Bibl: State Mineralogist's Report XVII, p. 350.

Reward Mine. It comprises a group of 5 claims located in the Goldstone District, about 5 miles southeast of Goldstone and 33 miles north of Barstow. Owner, Walter Sprigg, Goldstone, California. Elevation 4000 feet.

The vein has a width of 2 feet, strikes N. 20° W., and dips 40° W. Development consists of two shafts, 50 and 70 feet in depth. Idle.

Rose Mine. It is situated in the Bear Valley Mining District, in T. 2 N., R. 3 E., S. B. M., 40 miles southeast of Victorville and 5 miles southeast of Doble.

The formation is limestone, quartzite, mica schist and granite. The vein strikes east and west and dips 45° north. The orebodies are a mixture of quartz and calcite with streaks of hematite. Heavy hematite ore has been shipped from the mine containing from $200 to $500 per ton in gold.

Development consists of an incline shaft 450 feet in depth. It is stated that the shaft passes through the orebody between the 200 and 300 foot levels. The property had a production of $200,000 in gold. Idle.

Bibl: State Mineralogist's Reports XII, p. 234; XV, pp. 795–796.

Shaherald Mining Company has 4 claims, 80 acres, in the Kramer Hills District, 9 miles southeast of Kramer and 26 miles north of Adelanto. Elevation approximately 2700 feet. Owner, Shaherald Mining Company; C. F. Shaw, Jr., president, Fontana, California; T. C. McDonald, secretary, Rialto, California.

A description of this district has been given in the general remarks under 'Gold' in this report.

The schist belt in which the mineralization occurs has a width on this property of perhaps 200 feet. The strike is east-west, with a low dip (about 30 to 40°) to the south. Several narrow dikes of volcanic rocks have intruded the schist. These probably are connected with several flows which form the hill just north and west of this property. From the amount of brecciation and apparent lack of continuity of

these dikes, it is probable that there is considerable faulting here, but there is not sufficient underground work to definitely determine its extent. However, within a few feet of the surface the formation has been faulted along an east-west line with a throw of a few feet to the north.

Gold values are distributed throughout the schist belt to the depths prospected on this property, but the distribution is far from being uniform. Along the contacts of the narrow dikes with the schist, in the dike rock itself, in the brecciated material which frequently accompanies the dikes and in veins wholly within the schist (which are never far removed from the dikes), high-grade spots and small pockets are encountered. The veins proper, to depths yet explored, are filled with talc. When the talc contains quartz grains, gold is also present, some of it being very rich. The dike rock, which is highly stained with iron and manganese compounds, also carries gold, in places quite rich. This gold is always fine and 'rusty.' The brecciated material, which consists of schist fragments and, largely, clay, carries gold when the granulated quartz is present. Gold also occurs in the joints developed in the schist itself.

Much sampling has been done on this property in an attempt to determine the average values. Most of these samples come from the workings of an incline shaft. This shaft was sunk on an inclination of about 35° for a distance of 60 feet. Approximately 400 feet of drifts and crosscuts were driven on two levels which are only 15 feet (vertically) apart. These workings are connected with a 65-foot vertical shaft, by means of a 25-foot winze and a 65-foot crosscut. This vertical shaft is south of the incline shaft and was sunk wholly within the schist. Samples cut at 5-foot intervals in the crosscut showed average values of $4.50 per ton, $8 being the upper limit and $2 the lower. Just opposite the winze, which is 50 feet southeast of the shaft, a raise was driven which practically connects with the bottom of a shallow shaft. There is a vertical shaft 100 feet deep, two 50-foot vertical and one 75-foot vertical shaft, in addition to numerous open cuts and shallow pits on the property. A systematic sampling of the workings of the incline shaft, including the 65-foot vertical shaft and crosscut, gave an average value of $3.50 after elimination of all assays which ran $10 or over. It was found that 12 per cent of the samples showed values greater than $10. These were all eliminated. This average was further confirmed by the milling of approximately 100 tons, from which $1.55 per ton was recovered on the plates. The tailings ran $1.75. The low recovery by amalgation was largely due to the sticky talc and to the 'rusty' and very fine gold in the ore.

A mill was erected on the property consisting of the following: A double-drum dragline hoist, which carried the ore from the shaft to top of mill bin; grizzly, small jaw crusher; reciprocating feeder; 3-foot Herman ball mill, plates and 2 Service concentrators. A pump run by a 25-h.p. 'hot head' engine was installed at Jim Grey siding on the Santa Fe Railway and 3½ miles of 3-inch pipe laid to tanks on the hill above the mill. Water was hauled from Hinckley in railroad tank cars and pumped to the mill. It is reported that water has been developed in quantity by a well which was sunk alongside this pipeline about one mile north of the mill. Idle.

Sidewinder Mine is 13 miles east of Victorville, in the Highland Mountain, at an elevation of 3800 feet. Owner, *The Armstrong Mining Company;* W. B. Armstrong, president; J. J. Sammett, secretary, Hollywood, California.

This property, now consisting of 4 claims, was first opened some 45 years ago. As early as 1889 there was a 100-foot shaft, with an 80-foot drift and open cuts on the property. In 1887, a 10-stamp mill was erected at Victor (now Victorville) to treat the Sidewinder ore, which was reported at that time to yield $30 per ton in free gold.

The rocks of this mountain are essentially granitic, with possibly some thin beds of limestone. The vein, strike NW.-SE., locally shows a schistose to slaty hanging wall and a syenitic footwall. The dip is to the west, varying from 35 to 45°. It is traceable across the property for about 3000 feet.

A crosscut tunnel was driven southerly and is known as the 200-foot level. From where it intersects the vein, drifts have been driven NW. and SE. An old shaft passes through this level and 200 feet below, with development and some stoping on two levels below the tunnel. This inclined shaft 400 feet deep has about 1000 feet of drifts on the first level, 1300 feet on the second or tunnel level and over 400 feet on the third level and 300 feet on the fourth level; also a 200-foot shaft on the Keyholes Claim, with 500 feet of drifts and some stoping. There are reported to be four other shafts on this property, averaging 200 feet in depth.

Present work consists of sinking a new shaft started from the tunnel level, at a distance of about 500 feet southeast of the old shaft. Part of this shaft was made by timbering in an old stope. In November, 1929, it was down to the 508-foot level. A station was to be cut at 510 feet and the shaft carried down to an undetermined depth. Also a new haulage tunnel 700 feet long had been driven from the new shaft to the outside. On account of the shaft timbering, the vein was only visible in the bottom. Here it showed a width of about 5 feet in 3 sections. The center section, 2½ feet wide, is talcose schist, carrying pyrite. On each side is 1 to 1½ feet of iron-stained quartz. No idea of the average values could be obtained but previous operations would indicate from $6 to $7 per ton.

An underground electric hoist has been installed to serve the new shaft. A cyanide mill was erected here in 1927–28. Water for the mill is hauled from the company's well 5 miles away. Power is supplied by the Southern Sierras Power Company, a line having been brought from Victorville.

Mill equipment consists of Baash-Ross jaw crusher (200-ton capacity); conveyor to crushed ore bin; 4 foot by 6 foot Marcy-type mill; Dorr classifier in closed circuit with 5 foot by 16 foot tube mill; 24 foot Dorr thickener; 2 Devereaux agitators; American filter; Butters filter for clarifying pregnant solution; zinc dust precipitation. There is also a Grotch flotation machine, presumably installed to handle lead ore from a parallel vein on the property. All machines have individual motor drives.

At the time of visit 16 men were employed sinking the shaft and making changes at the mill.

Bibl: State Mineralogist's Reports IX, p. 227; X, pp. 527-528; XII, p. 235; XIII, p. 328.

Silver Dome Mine, consisting of 10 lode and 8 limestone placer claims, is in the Fremont Peak District, in Sec. 32, T. 12 N., R. 42 E., M. D. M., about 20 miles southeast of Randsburg. Elevation 2450 feet. Owner, Silver Dome Mining Company; Capt. A. Rolling, president; Fred Knappen, secretary. Offices, formerly in Wright-Callendar Building, Los Angeles.

This property is in the low, rolling hills just west of Fremont Peak. It was discovered in 1920 and taken over by the above company in 1922.

A series of 4 parallel fault fractures occur in the granite. The principal vein, on which the development work has been done, is accompanied by a diabase dike, the vein being on the hanging wall side of the dike. The average width is 4 feet with a maximum of 8 feet. It has been proved on the surface for a length of 4500 feet. The vein filling consists of quartz and calcite with enclosed wall rock. Mineralization includes chalcopyrite, pyrite and bornite, with values in gold and silver.

Developments consist of a shaft sunk on an incline of 45° to 200 feet and about 85° for 250 feet, a total depth of 450 feet. At 150-foot level, there is a drift 15 feet west; on the 265-foot level, a drift 114 feet east, with 15 feet of a crosscut south 56 feet from the shaft; also drift 50 feet west of shaft. High-grade spots were encountered in this work and it is reported that values on the 265-foot level would average 3 to 12 per cent in copper, $7 to $20 gold and 7 to 15 ounces of silver.

Equipment consisted of 25-h.p. Western gas engine hoist; two 9 inch by 14 inch Chicago pneumatic compressors direct connected to 'hot head' engines; a No. 5 Cameron pump; cars; blacksmith shop; and dwellings.

Idle except for assessment work.

Southern Cross (formerly the *Little Annie*), consisting of one claim, is in the Silver Mountain District, about 6 miles east of Oro Grande. Elevation about 3500 feet. Owners, Mark Low and Sam Weed, Victorville, California.

Quartz vein in rhyolite, up to 6 feet in width. Strike N. 45° E., dip 30° SE.

Development consists of three shafts, having reported depths of 50 feet, 100 feet, and 50 feet, on the vein, respectively. It is reported that there is a drift 200 feet southwest at the bottom of the 150-foot shaft and that the vein at this depth shows a width of 3 feet and will pan gold. Some ore was milled at Victorville several years ago with a reported production of $2,000.

Idle except for assessment work.

St. Elmo Mine. It comprises 6 patented lode claims situated in the Atolia Mining District, one-half mile south of Atolia and 5 miles south of Randsburg. Owner, Thomas R. Hanna, Martinez, California. Elevation 3400 feet.

Two well-defined veins occur in quartz-monzonite, strike N. 30° E., dip 80° NW., and N. 40° E., dip 80° NE. The widths of these two veins vary from 4 to 10 feet. The veins are 325 feet apart at the shaft and are connected by a crosscut on the 250-foot level. There is a possibility that about 458 feet south of the shaft these veins will

converge. On the west vein there is a vertical shaft 250 feet in depth, with drifts on the 100-foot, 150-foot and 250-foot levels. For a distance of 200 feet south of the shaft the vein has been stoped from the 150-foot level to the surface. On the last vein there is a shaft 150 feet deep and also open cuts and shallow shafts along the vein outcrop. The vein has a width of 4 to 8 feet. The vein has been stoped to the surface for a distance of 300 feet above the 100-foot level.

The mine was discovered in the late nineties and the production from 1897 to 1898 was $140,000. The ore shipped from the property to the Selby Smelting Company, netted $350 per ton. Idle.

Supply Mine. It comprises 9 patented claims situated in the Dale Mining District, in Sec. 35, T. 1 N., R 11 E., S. B. M., on the west

One hundred-ton mill and tailings dumps. Supply Mine, Dale Mining District, San Bernardino County.

slope of the Dale Hills, 15 miles east of Twenty-nine Palms. Elevation 2350 feet. Owners, Seely Mudd Estate and Philip Wiseman, Los Angeles.

This property is the most important mine in the Dale Mining District and for many years was a regular producer, having yielded over $500,000. The formation is andesitic porphyry. There are two veins known as the Supply and Jean. The veins strike north and south and dip 70° east. The widths of the veins vary from 4 to 10 feet. The Supply and Jean veins are about 1000 feet apart. The vein material is iron-stained quartz, showing considerable hematite, also copper stained. The ore mined and milled is said to have had an average value of $9 per ton. The Supply vein was developed by a shaft 1250 feet deep, sunk on an incline of 70°, with levels at 100-foot intervals. There are over 5000 feet of underground workings on the vein. The development on the Jean vein consists of an incline shaft about 200 feet in depth.

The ore was treated by dry crushing and direct cyanidation. The capacity of the mill was 100 tons per 24 hours. The mine was operated steadily until 1915 and in 1928 was reopened and operated under lease and bond by the *Arrowhead Development Company,* of Nevada, for a short time. Idle.

Bibl: State Mineralogist's Report XV, p. 802.

Tillie Rand Mine. It comprises 11 claims located in the Fremont Peak Mining District, on the east slope of Fremont Peak, 20 miles southeast of Randsburg. Owner, Tillie Rand Mining Company; A. C. Schurmer, president, Los Angeles.

A series of parallel veins in hornblende granite; strike north and south and dip steeply to the west. The veins vary in width from 2 to 4 feet. The principal development has been confined to a shear zone in the granite. The total width of the vein that follows this shear zone is 4 feet, with 2 feet of quartz. The other vein material is decomposed granite on the footwall and granite-porphyry on the hanging wall.

Development consists of a shaft about 200 feet deep and a number of shallow shafts and open cuts on the different veins. Idle.

U. S. Group of 4 claims is in the Von Triger District, 14 miles north of Goffs. Owners, S. A. and George W. Golden, Daggett, California.

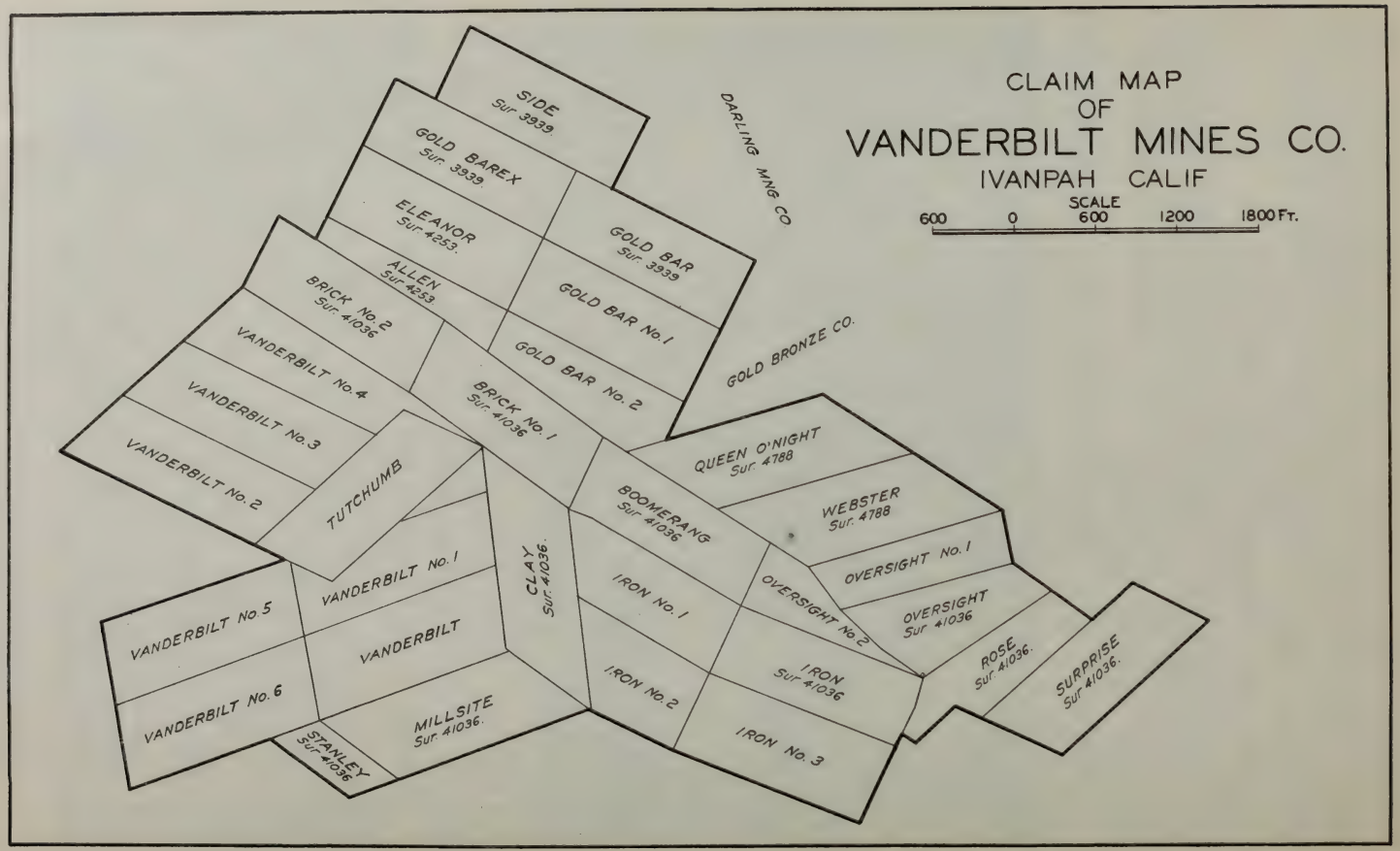
It is reported that a porphyritic dike 12 feet in width, strike east-west, dip 45° south, is traversed by numerous quartz stringers, samples from which assay from $3.50 to $100 per ton.

Development consists of an incline shaft 30 feet deep.

Idle except for assessment work.

Vanderbilt Mines, comprises a group of 38 claims, of which 18 claims are patented, situated in the Vanderbilt Mining District, on the west slope of the New York range of mountains, 4 miles east of Ivanpah, a station on the Union Pacific Railroad. Elevation 5000 feet. Owner, Vanderbilt Mining Company, Allen G. Campbell Estate, of Riverside, California. Under option to the *Reorganized Silver King Divide Mining Company;* Schad Smith, president; H. G. Humes, vice president and general manager; H. W. Smith, secretary; I. S. Hardester, superintendent. Offices, 434 I. W. Hellman Building, Los Angeles.

The rocks of the district are chiefly gneissoid and schistose, granitic and hornblende rocks, intruded by pegmatite dikes. A series of parallel veins occur in granite, strike N. 70° W., dip 60° to 70° N. The most important veins are the Gold Bar and the Boomerang veins, which are about one-half mile apart. The Gold Bar vein system consists of a hanging wall and footwall vein, which are about 20 feet apart. These veins are separated by quartz-porphyry, and the walls are an altered granite. The oxidization extends from the surface to a depth of 150 feet, where sulphide ore was encountered. The vein quartz in the oxidized zone is heavily mineralized with hematite. The vein quartz below the 150-foot level is mineralized with pyrite, marcasite, galena and chalcopyrite. Sixteen cars (50 tons each) of ore mined from the 150-foot level of the Gold Bar shaft and shipped to the International Smelter at Salt Lake, Utah, averaged $20 per ton in gold and silver.


CLAIM MAP
OF
VANDERBILT MINES CO.
IVANPAH CALIF
SCALE
600 0 600 1200 1800 FT.
SIDE
Sur. 3939.
GOLD BAREX
Sur. 3939.
ELEANOR
Sur. 4253.
ALLEN
Sur. 4253
GOLD BAR
Sur. 3939
GOLD BAR No. 1
GOLD BAR No. 2
DARLING MNG CO
GOLD BRONZE CO.
BRICK No. 2
Sur. 41036
VANDERBILT No. 4
VANDERBILT No. 3
VANDERBILT No. 2
TUTCHUMB
BRICK No. 1
Sur. 41036
QUEEN O'NIGHT
Sur. 4788
WEBSTER
Sur. 4788
BOOMERANG
Sur. 41036
OVERSIGHT No. 1
OVERSIGHT No. 2
OVERSIGHT
Sur. 41036
CLAY
Sur. 41036
IRON No. 1
IRON No. 2
IRON
Sur. 41036
IRON No. 3
ROSE
Sur. 41036.
SURPRISE
Sur. 41036.
VANDERBILT No. 5
VANDERBILT No. 6
VANDERBILT No. 1
VANDERBILT
MILLSITE
Sur. 41036.
STANLEY
Sur. 41036

The general grade of ore that has been developed on the property that has been determined by careful sampling, is as follows:

Gold	0.62 ounces
Silver	3.74 ounces
Lead	0.70 per cent
Copper	0.51 per cent
Insoluble	71.60 per cent
Iron	7.80 per cent
Sulphur	4.70 per cent
Lime	2.20 per cent

The average value of ore shipments were as follows:

Gold	0.72 ounces
Silver	3.50 ounces
Copper	0.50 per cent
Lead	0.80 per cent
Iron	8.00 per cent
Silica	74.00 per cent

The Gold Bar lode has been developed by three shafts known as the Gold Bar, Ed and Baldwin. The Baldwin shaft is the most westerly shaft on the vein, being 270 feet west of the Ed shaft which is 230 feet west of the Baldwin shaft. The Gold Bar shaft is 425 feet deep sunk on an incline of 60°. The Ed shaft is 400 feet deep on the vein. The Baldwin shaft has been sunk on the vein to a depth of 300 feet. The ore developed on the 200-foot level is 250 feet in length, with an average width of 8 feet. The average value is said to be $20 per ton in gold and silver.

Development on Gold Bar Vein: The Baldwin shaft is sunk on the hanging wall vein, with crosscuts on the different levels to the footwall vein, and the ore developed on the latter vein is said to contain the highest values. On the 100-foot level, the Gold Bar shaft connects with the Ed shaft and is driven 100 feet east of Ed shaft. Ore is stoped from 100-foot level to the surface. On the 200-foot level of the Gold Bar shaft there is a drift east 250 feet, drift west 25 feet. The Boomerang shaft has been sunk on the Boomerang vein system to a depth of 565 feet. This vein system consists of two parallel veins about 100 feet apart. The average width of this vein is 8 feet and it is said the average value is $20 per ton in gold and silver.

On the 100-foot level drift east 260 feet and west 230 feet.

On the 200-foot level drift west 140 feet and east 80 feet.

On the 300-foot level drift 165 feet east.

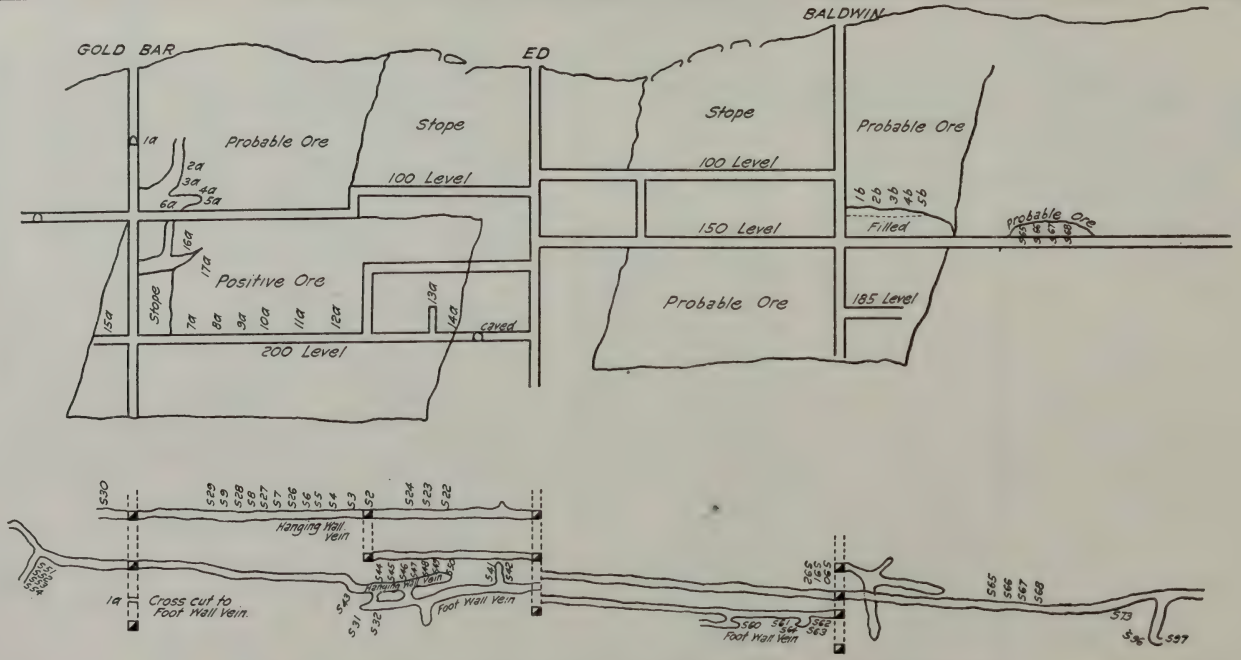
On the 400-foot level drift 60 feet west and east 55 feet. On 400-foot level about 25 feet west of shaft there is a crosscut north 50 feet.

On the 500-foot level drift east 110 feet and west 40 feet.

The ore shoot developed and stoped on the 100-foot level was 250 feet in length, with an average width of 8 feet.

Mine equipment consists of 15-h. p. Fairbanks-Morse hoist at Baldwin shaft. 22-h. p. hoist at Gold Bar shaft; and Ingersoll-Rand 9-inch by 8-inch compressor.

This company is unwatering the Gold Bar and Baldwin shafts, also retimbering the underground workings. It is planned to unwater the



PLAN AND SECTION OF UNDERGROUND WORKINGS
OF THE
GOLD BAR AND BALDWIN SHAFTS
VANDERBILT MINES CO. IVANPAH CALIF.

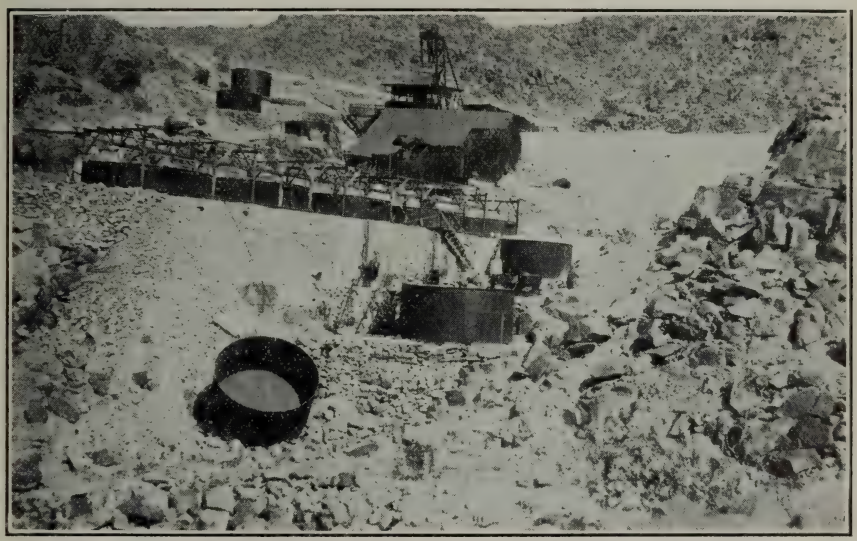
SCALE
60 0 60 120 180 FT.

Boomerang shaft and retimber the underground workings. Mill tests are being made on the ore from the Gold Bar workings to determine the best method of treatment. Flotation tests so far made indicate a recovery of 96 per cent of the gold and silver values. Eight men are employed.

Bibl: State Mineralogist's Reports XI, pp. 367–368; XII, pp. 235–237; XIII, p. 329; XV, p. 816.

Virginia Dale Mine. It comprises 6 claims with 6000 feet on the lode, situated in the Dale Mining District, in Sec. 29, T. 1 N., R. 12 E., S. B. M., 18 miles east of Twenty-nine Palms. Elevation 2000 feet. Owner, Virginia Dale Mining Company; Judge J. A. Reese, president; A. D. Blehm, secretary, San Bernardino, California.

Three parallel veins occur in quartz-diorite and are about 150 feet apart. These veins strike N. 20° W. and dip from 70° to 80° E. The



Headframe and 50-ton mill. Virginia Dale Mine, Dale Mining District, San Bernardino County.

veins vary from 4 to 6 feet in width. The main development is confined to the Middle vein. The vein quartz is iron-stained, being mineralized with hematite, magnetite and manganese. The values vary from $9 to $20 per ton in gold, average value being $12 per ton.

Development consists of a shaft 350 feet in depth sunk on an incline of 70°.

On 100-foot level drift north 350 feet and south 300 feet.

On 200-foot level drift south 300 feet and north 300 feet.

Three ore shoots have been developed in the form of lenses of quartz in the fissure. These shoots vary from 50 to 100 feet in length, with an average width of 4 feet.

Mine equipment consists of 15-h. p. gas engine hoist. Mill equipment consists of 8-inch by 10-inch Blake crusher; National crusher mill, where ground to 20-mesh, the pulp from ball mill passing over

amalgamation plates then to cyanide plant. Reported recovery is said to be 90 per cent. Mill has a capacity of 40 tons per 24 hours. The plant is driven by 25-h.p. West Coast gas engine. The water supply is secured from a well at Old Dale, about 5 miles northwest of the mine. Water is pumped through 2-inch pipeline to storage tanks having a capacity of 35,000 gallons.

The mine has been operated off and on since 1896. Last operations were in 1928 and 1929 and it is said that the company intends to resume operations in the very near future. Six men are employed in remodeling mill and building new bunkhouse.

Bibl: State Mineralogist's Reports XIII, p. 314; XV, p. 802.

White Nugget Group of Placer Claims. This group of 4 claims is situated at Coolgardie in the SE¼ of Sec. 24, T. 32 S., R. 1 W., S. B. M. 15 miles north of Barstow. Owner, A. J. Rearkrant and Earl Rose, Pasadena, California.

The gravel is worked by means of dry washers and is said to carry values varying from 50 cents to $2 per cubic yard. Idle.

Winchester Group of Claims. This group comprises 5 claims, situated in the Arrow Mining District, on the east slope of Providence range of mountains, 20 miles west of Fenner, a station on the Santa Fe Railroad. Owner, George Kinney, Avalon, Catalina Island. The claims adjoin the Hidden Hill group of mines.

A series of parallel veins in granite porphyry, strike N. and S., dip 45° W. Widths vary from 12 inches to 2 feet. Developments consist of tunnels and shafts. Idle.

Yankee Maid Mine. It comprises 6 claims located 8 miles north of Oro Grande, a station on the Santa Fe Railroad. Elevation 4000 feet. Owner, *Golden King Mining and Milling Company,* Victorville.

The vein occurs in granite. Development consists of two shafts 100 and 140 feet in depth. Formerly operated by the *Yankee Maid Mining and Milling Company,* of Victorville, California. Idle.

Bibl: State Mineralogist's Report XV, p. 814.

IRON

Large deposits of iron ore occur in the desert regions of San Bernardino County. It is estimated that there are 200,000,000 tons of high grade ore available and double that amount of probable ore in Riverside and San Bernardino counties. The iron ore deposits of San Bernardino County will eventually become of importance, both on account of the exhaustion of high grade ores in the eastern section of the country and because of the necessity for supplying the growing demands of the Pacific Coast.

Geology.

The principal iron deposits of Riverside and San Bernardino counties are the contact replacement type that form at or near the contact of an intrusive igneous mass with sedimentary strata, usually limestone.

For detail description of the different deposits see U. S. G. S. Bulletin No. 285, p. 198; U. S. G. S. Bulletin No. 430, pp. 228–239; Bulletin of

A. I. M. E., September, 1915; State Mineralogist's Report IX, p. 235; Report XV, pp. 817–821; Bulletin No. 38, p. 299.

Deposits.

Cave Canyon Iron Deposit. It is situated in Secs. 12 and 13, T. 11 N., R. 7 E., S. B. M. Holdings consists of 10 claims known as the Cave Canyon Group (all patented), about one-quarter of a mile north of Baxter, a station on the Union Pacific Railroad. Owner, E. H. Harriman Estate, New York City.

The iron ore occurs on the contact of monzonite and a coarsely crystalline marble on the south, dipping southward at about 30°. The ore occurs in two belts. The western belt is 2000 feet long and the eastern 1700 feet in length. The width of the outcrop reaches a maximum of 450 feet. The average width of the western belt is 300 feet and the eastern belt has a width of 100-feet. The ore is mainly red hematite and limonite. Commercial analysis shows 60 per cent iron, with low phosphorus.

Development consists of four tunnels. Estimated tonnage is 10,000,000 tons.

Bibl: State Mineralogist's Report XV, p. 818; Bull. 38, p. 299.

Iron Age Iron Deposit. It comprises 3 patented claims, situated in Sec. 29, T. 1 S., R. 13 E., S. B. M., 6 miles east of Dale, and about 45 miles by road south of Amboy, a station on the Santa Fe Railroad. Owner, A. R. Rhea, Los Angeles.

The iron ores are largely hematite, altered from magnetite, in the form of veins cutting intrusive granite and granite porphyry. The principal iron-ore veins occur over an area about one-half mile square, the larger ones forming the summit of a large hill. The ores are very pure and high grade but the veins are not of sufficient extent to warrant the possibility of developing a large tonnage.

Bibl: State Mineralogist's Report XV, pp. 818–819; Bull. 38, p. 299; U. S. G. S. Bull. 340, pp. 228–239.

Iron Hat Group (formerly called the *Ironclad Group*), of 7 claims, is in the Marble Mountains, 14 miles east of Amboy. Elevation about 4000 feet. Owner, T. Schofield, Amboy, California.

The rocks exposed on this property consist of dolomitic limestone, felsite, quartz porphyry and diorite. The limestone has been pushed up and intruded by the igneous rocks. It now outcrops in the shape of a crescent. The strike varies from northwest in the canyon to northeast on the south slope of the mountain. On the north end of the property, a quartz porphyry is in contact with the dolomitic limestone. In fact, practically all of the exposed contacts consist of quartz porphyry and limestone but where tunnels have been driven there is a varying thickness of diorite between the two.

The deposits are on the contacts, dip from 50 to 85° in an easterly direction. In the canyon an iron 'vein' outcrops. It is from 8 to 10 feet wide, strike NW., dip 80° NE. At the top of the mountain to the north this 'vein' merges into a very prominent iron outcrop, having a total width of 40 to 50 feet, with a narrow diorite dike in its center. In a canyon northeast of this ridge, this outcrop disappears

but shows again very prominently on the next ridge. It is from this second ridge that some 2000 tons of ore were shipped to the Llewellyn Iron Works in Los Angeles. This ore is reported to have averaged 65 per cent iron. The ore is a black hematite, with some specular iron and magnetite.

Development work consists of two tunnels, one 40 feet long and the other 100 feet. The 100-foot tunnel is a crosscut, which passes through the quartz porphyry and into the ore at a distance of 60 feet from the portal. These tunnels and various opencuts constitute the development work.

Idle except for assessment work.

Iron Mountain Deposit. This deposit is in the Lava Bed Mining District, in Secs. 27 and 28, T. 6 N., R. 4 E., S. B. M., about 18 miles southeast of Newberry, a station on the Santa Fe Railroad. Holdings comprise 7 claims, totaling 140 acres. Owners, Mrs. Phoebe Owens, San Francisco, and E. S. Lake, Los Angeles. Elevation 3000 to 3880 feet.

Two massive veins of hematite and magnetic iron ore occur on a ridge known as Iron Mountain, which is the southeasterly prolongation of the Ord Range of mountains. The veins of iron ore occur in granitic rocks; they strike N. 20° E., dip 30° NW. The veins are about 150 feet apart and vary in width from 30 to 400 feet. The ore occurs on contact of dolomitic limestone and granite on the Tip Top Claim. On the Bessemer Claim, the strike of the large deposit of iron ore is north and south. The iron ore deposits can be traced along their strike for a distance of 320 feet, with an average width of 80 feet, increasing in places to 400 feet. The deposit is reported to contain 10,000,000 tons of commercial ore.

Analysis of ores is as follows: Iron, 65 per cent; phosphorus, .045 per cent; silica, 3.05 per cent; sulphur, .06 per cent.

Bibl: State Mineralogist's Reports IX, p. 235; XV, p. 819; S. M. B. Bull. 38, pp. 299–300.

Iron Mountain Group is in Secs. 11, 12, 13 and 14, T. 15 N., R. 6 E., S. B. M., 10 miles west of Silver Lake, a station on the Tonopah and Tidewater Railroad. Holdings comprise 6 patented claims. Owner, *Colorado Fuel and Iron Company,* Denver, Colorado.

There is 12,000,000 tons of commercial ore in this deposit.

Bibl: State Mineralogist's Report XV, p. 820.

Kingston Mountains Iron Deposit. A large deposit of iron ore occurs in the Kingston Mountains, in T. 25 S., R. 11 E., S. B. M., 25 miles southeast of Sperry, a station on the Tonopah and Tidewater Railroad. Owner, *Pacific Coast Steel Company,* San Francisco. Holdings comprise 6 patented claims.

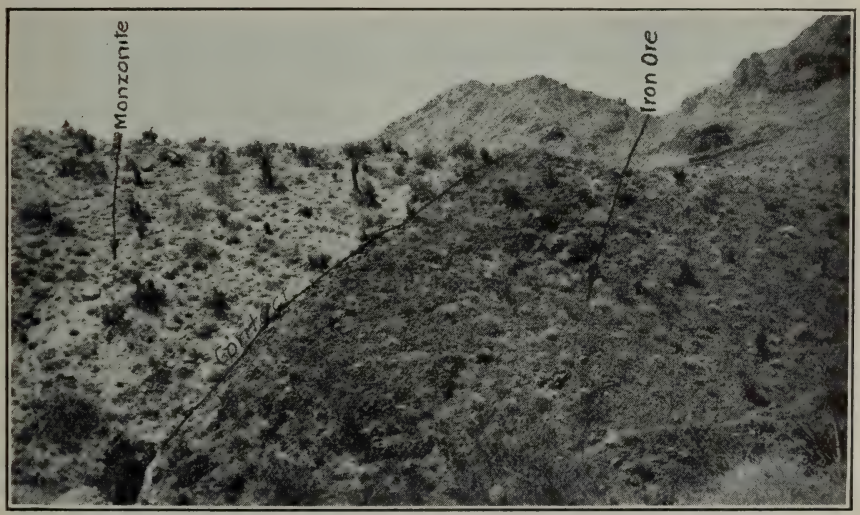
The ore is hematite and magnetite which occurs near the contact of intrusive mozonite and limestone. During recent years the deposit was thoroughly prospected with diamond drills by the above-mentioned company, and it is estimated that the deposit contains 12,000,000 tons of commercial ore. Idle.

Bibl: Bull. 38.

Ship Mountains Iron Mine, consisting of 7 claims, is in the Ship Mountains, 2½ miles south of Siam, a station on the main line of The Atchison, Topeka and Santa Fe Railroad. Elevation about 3500 feet. Owner, Earl W. Paul, Upland, California.

Although this property has been developed by a 500-foot shaft, observations could only be made on the surface, as a recent fire had destroyed the surface plant, burning the timbers in the shaft and causing it to cave. This was very unsatisfactory as the entire surface is covered with vesicular, basaltic boulders.

The mineralized zone, strike N.-S., dip 45° E., has a diabase hanging wall and dolomitic limestone footwall. It is traceable for about one mile on this property. The ore is red hematite and in places it shows oxides of copper and copper sulphate stains. This zone has a width up to 600 feet and appears to consist of a series of veins in



Vulcan iron deposit. Outcrop 385 feet wide by 80 feet high.

the diabase, with the limestone as the footwall of the zone and the principal vein is at the contact.

It is reported that 30 cars have been shipped to the Southern California Iron and Steel Company and to the Llewellyn Iron Works. It is said that it averaged 60 per cent iron, with low sulphur and silica and practically no phosphorus.

Development is reported to consist of a 500-foot inclined shaft with the following lateral developments:

Level	*Drift North*	*Drift South*
100-foot	Approximately 50 feet	Approximately 50 feet
150-foot	Approximately 75 feet	Approximately 75 feet
200-foot	Approximately 75 feet	Approximately 75 feet
250-foot	Approximately 70 feet	Approximately 65 feet
400-foot	Approximately 65 feet	Approximately 70 feet
500-foot	Approximately 25 feet	

There were 2 stopes on the 100-foot level. The ore in one of these is reported to have a width of 30 feet. The ore was encountered in all of these levels except the 500 foot.

It is reported that the claims are now being patented.

Vulcan Iron Deposit. It is situated in the Providence range of mountains, 9 miles southeast of Kelso, a station on the Union Pacific Railroad. Elevation 3700 feet. Holdings comprise 5 patented claims containing 100 acres, in Sec. 25, T. 10 N., R 13 E., S. B. M. Owner, C. Colcock Jones, Los Angeles.

The ore deposits are typical contact iron replacements of dolomitic limestone at or near an intrusive mass of monzonite. On Vulcan No. 2 Claim, there is exposed a solid mass of iron ore 800 feet in length and 350 feet in width, which rises to a height of 260 feet at the east end and 80 feet at the west end of the deposit. The area of this outcrop of iron ore is 4 acres. It is estimated that this deposit contains from 4,000,000 to 8,000,000 tons of commercial ore. A number of smaller outcrops occur along the contact of the limestone and monzonite at intervals for a distance of 4000 feet. The ore is a soft hematite and from analysis contains: Iron, 64.83 per cent; phosphorus, 0.044 per cent; silica, 3.04 per cent; sulphur, .06 per cent.

Development consists of one tunnel, shafts and opencuts. Idle.

Bibl: State Mineralogist's Report XV, pp. 820–821; Bull. A. I. M. E., September, 1915, p. 1889; E. and M. Journal, April 17, 1909.

MANGANESE

Deposits of manganese ore occur in the desert regions of San Bernardino County, in the Lavic Mountains, Owl Mountains, Whipple Mountains and along the Colorado River near Parker. The only deposit of commercial importance, so far developed, is the Owl Hole Manganese Mine, in the Owl Mountains, 36 miles west of Riggs, a station on the Tonopah and Tidewater Railroad. This deposit was extensively worked from 1915 to the latter part of 1918, and produced a large tonnage of high grade ore; of the other deposits mentioned, the silica content is too high to make them of commercial importance.

Deposits.

Black Stone Manganese Deposit. It is 3 miles southeast of Afton, a station on the Salt Lake Railroad, on ridge east of the Mojave River. Elevation 2600 feet. Owner, J. H. Massen, Yermo, California.

A series of lenses of manganese occur on contact of granite and limestone, for a distance of about 1000 feet. The strike of the contact is north and south, with a dip of 70 degrees to the east. The largest lens noted was about 60 feet, in length and 8 to 10 feet wide. The fracture can be traced for a mile and at intervals shows from 8 inches to 4 feet of ore. Manganese occurs in the form of psilomelane, with a small amount of pyrolusite. Idle.

Bibl: State Mineralogist's Report XVII, p. 354.

Emma Group of Manganese Claims. The deposit is located 36 miles west of Riggs, a station on the Tonopah and Tidewater Railroad, about one mile north of the Owls Hole Mine. Owner, Ruben Stinton, Silver Lake, California.

At an elevation of 2800 feet, on ridge north of Owls Hole Mine, a vein of manganese occurs on contact of granite and limestone. The outcrop can be traced along the contact for several hundred feet. Manganese occurs as pyrolusite and shows a low silica content. Developments consist of a series of short tunnels. Idle.

Bibl: State Mineralogist's Report XVII, p. 354; Bull. 76, p. 62.

Lavic Mountain Deposits. These deposits are situated 5 miles northwest of Ludlow in the Lavic Mountains. Owners, Al. Seymour, I. D. Garinger and L. N. Root, Daggett, California.

Manganese oxides occur along a series of parallel fractures in a rhyolite breccia. The outcrops can be traced for a distance of one mile. The veins strike N. 60° W., with dip of 60° SW. The veins have widths of 12 inches to 3 feet. Ore is psilomelane. Developments consist of a series of open cuts on different veins. In 1917, 100 tons of ore were shipped from the property. Ore carries high silica content. Idle.

Bibl: State Mineralogist's Report XVII, pp. 354–355; Bull. 76, p. 62.

Owls Hole Manganese Mine. It is situated 36 miles west of Riggs, a station on the Tonopah and Tidewater Railroad, northwest of Owl Hole Spring, Owl Mountains, and southwest of Death Valley narrows. Elevation 2400 feet. Formerly under option to C. E. Starr, Los Angeles: 40 claims of this group are owned by E. W. and E. E. Williams and two claims by G. W. Rose, Silver Lake, California.

The manganese oxides occur along a series of fault fractures which strike NW. and SE. in granite and also on contact between the granite and limestone, the latter at one time covering the whole area of the granite, but has since been mostly eroded. At different points the granite is overlain by granitic conglomerate.

Two shafts have been sunk to a depth of 60 feet along these fractures, which are more or less parallel. The ore developed in these workings shows a width of 4 to 6 feet. There is also an open cut 150 feet in length on a parallel vein about 50 feet west of north shaft, showing 3 feet of ore in south face of cut. North of shaft in gulch there is an open cut where the manganese oxides occur on contact of limestone and a granitic conglomerate. The croppings at this point are 50 feet wide, and the ore is intermixed with the granitic conglomerate. At the edge of this cut a shaft is sunk 50 feet in ore. About $1\frac{1}{2}$ miles north of these workings there is a large body of manganiferous iron croppings 200 to 300 feet long and about 50 to 75 feet wide. Developed by a series of open cuts. Manganese oxides are psilomelane, pyrolusite and manganite. Calcite occurs in the fracture with the manganese oxides. Ore shipped from the property is stated to have carried 45 per cent to 70 per cent MnO_2. Ore was hauled by tractor and trucks to Riggs Station. Idle. Reported that production is to be started at this property in the near future.

Bibl: State Mineralogist's Report XVII, p. 355; Bull. 76, pp. 62–64.

Red Cross and Hidden Treasure Groups of Manganese Claims. These claims are located 11 miles north of Drenman, a station on Parker Branch of the Santa Fe Railroad, in the Whipple Mountains.

Elevation 2300 feet. Owners, Fred W. Hall and Mrs. Maude Washbesh, Parker, Arizona.

Manganese ore occurs as lenticular and irregular masses in the sandstone, limestone and volcanic breccia. Some of the orebodies are connected with northwesterly fissures along bedding planes. There are many outcrops of ore on the claims, but only a few have been exploited. One deposit enclosed in volcanic breccia is 25 feet long and 4 feet wide. At two other places ore occurs in fissures in the limestone. Bodies are 8 feet wide and 25 feet long. Manganese ore consists of massive psilomelane with a small amount of pyrolusite present. The ore is high grade. Shipments of ore are stated to have yielded 45 per cent manganese, 4 per cent silica, 2 per cent iron, and 0.04 per cent of phosphorus. Idle.

Bibl: State Mineralogist's Report XVII, pp. 355–356.

MOLYBDENUM

The two principal molybdenum minerals are the sulphide, molybdenite, and wulfenite, lead molybdate; the former furnishing practically the entire commercial output. Molybdenite is found in or associated with acidic igneous rocks, such as granite and pegmatite.

Deposits of disseminated molybdenite are known in several localities in San Bernardino County. In the New York Mountains it occurs in small masses, associated with copper ores. Small kidney-like deposits of molybdenite also occur in a granitic gneiss on the ridge west of the south fork of Lyttle Creek, 2 miles west of Glen Ranch. The occurrence of molybdenum is also reported near Bonita Falls, on the south fork of Lyttle Creek. So far, no commercial deposits have been developed.

QUICKSILVER

Desert Mercury Group of 9 claims is in the Old Woman Mountains, 12½ miles southeast of Danby, a station on The Atchison, Topeka and Santa Fe Railroad. Owners, S. M. Mingus, Glendale, California; A. F. de Steiger, Danby, California; A. F. Wagner, Chula Vista, California; and A. E. Barron, San Diego, California.

A series of roughly parallel quartz-porphyry dikes here occur in granitic gneiss. The strike is N. 80° E., dip 60° S. Mineralization has taken place along the contact in the quartz porphyry and, in places, has penetrated the joints of the gneiss for a few feet from the dike. These dikes are traceable for about 2000 feet or more, across the property. The only metallic mineral observed was cinnabar. The mineralized zones sometimes reach a thickness of 12 to 15 feet, probably averaging 4 to 5 feet. While samples have shown as high as 3 per cent to 8 per cent mercury, no idea as to the average content of the ore could be obtained.

Development work consists of a series of open trenches on the various contacts.

Idle except for assessment work.

Idria Quicksilver Group, consisting of 8 claims, is in Sec. 24, T. 9 N., R. 18 E., S. B. M., in the Sacramento range of mountains, about 5 miles south of Goffs, a station on the Santa Fe Railroad. Elevation about 2500′. Owners, Frank M. Chausse and Thomas H. O'Mill of Goffs, California, and Mrs. Marie B. Gage of Los Angeles.

Numerous parallel veins traverse the floor of the canyon in a hornblende granitic-gneiss. Strike N. 70° E., dip varies from 30 to 35° NW. The ore occurs along the main fractures and joints in the brecciated wall rock. The wall rock has been greatly altered along these lines, principally by silicification, in places showing as much as four feet of solid chalcedony, through which is disseminated cinnabar in minute particles. The veins vary in width from a few inches to eight feet. Values up to 4% mercury are reported, but sufficient work has not yet been done to warrant a statement as to average values.

Development work consists of open cuts and two shafts each 25 feet deep. Idle at present but the immediate sinking of a shaft is contemplated.

SILVER-LEAD AND ZINC

Alta Mine, consisting of 11 claims is situated on the northwest slope of the Shadow Mountains, 1¼ miles east of Riggs, a station on the Tonopah and Tidewater Railroad. Elevation 1800 feet. Owner, Mrs. Frank Riggs, 1801 Oxley street, South Pasadena, California.

The ore, which consists of native silver, galena and chloro-bromides of silver, occurs in irregular lenses, along a series of north-south fault fractures and also at the intersections of these fractures, with east and west fissures, in the limestone. The north-south fissures dip 65° to 70° west and are filled with a heavily iron and manganese stained, porphyritic material. The high-grade ore, as a rule, is associated with barite.

Considerable development was done and a production of $200,000 was reported. Idle.

Bibl: State Mineralogist's Report XVII, p. 359.

Allie and Beatrice is an old property in the Ivanpah District, 20 miles northwest of South Ivanpah. Has long been idle.

Bibl: State Mineralogist's Report XV, p. 826.

Anaco Mine (formerly the *Red Rover*), comprising 12 claims, is in the Silver Mountain District, approximately 6 miles east of Silver Mountain, 5 miles north of Adelanto and 1 mile west of the Randsburg-San Bernardino highway. Elevation about 3000 feet. Owner, Anaco Mines Company; F. A. Rogers, president, San Gabriel, California; George W. Clark, secretary, Box 91, Adelanto, California.

Here a thick bed of dark, crystalline limestone has been intruded by a series of felsitic dikes, evidently offshoots from the granitic rock which marks the eastern boundary of the limestone. Strike of the limestone is N. 25° W., dip 75° to 85° to the west. The dikes seem to dip to the east. The ore occurs along the contacts of the dikes with the limestone and as a replacement along the bedding planes. Sufficient exploration work has not yet been done to determine the extent of the replacement. The most abundant metallic mineral appears to be sphalerite, with subordinate galena and silver minerals. No idea of average values could be obtained.

Developments consist of 100-foot vertical shaft (inaccessible) with a reported crosscut at the bottom, 15 feet west and a drift south. On the 25-foot level, present operators have drifted south 40 feet. This drift is connected by a raise to the surface, at a point 20 feet south of the shaft. Small, irregular lenses of ore occur throughout the length

of this drift. It is reported that there is 4 feet of good ore in the bottom of the 100-foot shaft. A 70-foot vertical shaft was sunk 300 feet south of these workings. This is also inaccessible. Between the two shafts is an open cut about 50 feet long. About 1200 feet north of these workings, the limestone is split by an intrusive mass which has a width of approximately 200 feet. Here, on the western portion of the divided limestone, an old shaft was sunk to a reported depth of 136 feet but no further information regarding this work is available.

Four men employed. At the time of visit they were excavating for a hoist which was to be placed at the 100-foot shaft.

Avawatz Crown Mine is in the Silver Lake District, 8 miles east of Riggs, a station on the Tonopah and Tidewater Railroad. Owner, *Avawatz Consolidated Mines Company;* Alvin B. Carpenter, president; M. L. Neely, secretary. Offices formerly in Citizens National Bank Building, Los Angeles.

On this property a highly brecciated quartzite, 210 feet wide and exposed for a length of several thousand feet, is mineralized across its full width. The richest portion is that next to the hanging wall, sample of which gave an assay result of 150 ounces silver, 20 per cent lead, with 5½ per cent copper and 6 per cent zinc. Samples taken across the entire width showed an average value of 4 ounces silver and 8½ per cent lead. This ore is in the form of a silver-bearing galena.

Development consists of 325-foot shaft, with 210-foot crosscut on the 300-foot level. Idle except for assessment work.

Bibl: State Mineralogist's Report XVII, pp. 359–360.

Bank Roll and Green Gold Groups, consisting of 6 claims, are located in the Clark Mountain District, in T. 17 N., R. 13 E., S. B. M., on the west slope of Clark Mountain, 7 miles northeast of Valley Wells and 23 miles north of Cima, a station on the Union Pacific Railroad. Elevation 6000 feet. Owner, Louis F. Keiper, Cima, California.

Narrow fissures, 8 inches to 2 inches wide, in quartz monzonite, near its contact with limestone, are filled with quartz. The valuable minerals in the quartz gangue are galena, sphalerite and chalcopyrite, which carry values in gold and silver. Strike of the veins is north-south. The average value of the ore is reported to be 20 ounces of silver and 25 per cent lead.

Development consists of a number of tunnels and open cuts on the various claims. Idle.

Bibl: State Mineralogist's Report XX, pp. 92–93.

Belcher Extension Mining Company, formerly operated in the Randsburg District. Their property was located southwest of the California Rand Silver Company's mine. A shaft was sunk to a depth of 432 feet and about 300 feet of drifting and crosscutting was done on the 230-, 330- and 430-foot levels. No commercial orebodies were developed. Idle.

Bibl: California State Mining Bureau Bull. 95, pp. 128–129.

Bell Gilroy Mine, comprising 3 claims, is in the Trojan District, on the eastern slope of the Providence Mountains, 22 miles northwest of Fenner, a station on The Atchison, Topeka and Santa Fe Railroad.

Elevation 4350 feet. Owner, A. A. Irish, 514 Grosse Building, Los Angeles.

The ore consists of argentiferous galena deposited in a silicified limestone breccia, near a contact with intrusive monzonite. The main orebodies occur at intersections of north and south fissures with east and west fissures. Developed by a number of short tunnels. Idle.

Bibl: State Mineralogist's Report XVII, p. 360.

Ben Hur Mine, consisting of one patented claim, on the line between San Bernardino and Kern Counties, is in the Randsburg District. It is about one-half mile southwest of the California Rand Silver Mine.

The Ben Hur Divide Mining Company sunk a 1½-compartment shaft to a depth of 400 feet on this property. They also did approximately 2000 feet of horizontal work on the 200-, 300- and 400-foot levels. This work prospected three veins which occur on the property, without disclosing an orebody of commercial value. Idle.

Bibl: California State Mining Bureau Bull. 95, p. 129.

Bevis Divide Mining Company sunk a 150-foot shaft on a small piece of ground leased from the *Pittsburg and Mt. Shasta Mining Company* in the Randsburg District. No vein was discovered. Idle.

Bibl: California State Mining Bureau Bull. 95, p. 129.

Big Four Mine is in the Randsburg District. The *Rand Consolidated Silver Mining Company, Inc.,* sunk a shaft on this property to a depth of 1300 feet. This shaft is located about 3300 feet northeast of the No. 2 shaft of the California Rand Silver Mine. No ore was encountered in these workings. Idle.

Bibl: California State Mining Bureau Bull. 95, p. 129.

Big Six. A small property lying east of the railroad in the silver belt of the Randsburg District. A shaft was sunk to a depth of approximately 300 feet without disclosing any ore. Idle.

Bibl: California State Mining Bureau Bull. 95, p. 130.

Bismark Mine (see Calico-Odessa Mining Company).

Black Foot-Golconda Group of Mines. This group comprises 22 claims, situated in Sec. 13, T. 10 N., R. 1 E., S. B. M., in the Calico Mining District, 3 miles northwest of Yermo, a station on the Union Pacific Railroad. Elevation 2700 feet. Owner, J. R. Lane, Calico, California.

The formation is rhyolite tuff and breccia. Chlorides and chlorobromides of silver occur in irregular fractures and joint planes along the Golconda-Black Foot fault. The course of this fault is northwest and southeast, dip 50° southwest. On the Black Foot Claim there is a mineralized zone extending over quite an area, which is in the form of an impregnated deposit, similar to the deposits found on the Humbug Claim. Workings consist of shallow shafts and open cuts. Idle.

Bob Lee and Hattie Groups are in the Ivanpah District. They have long been idle.

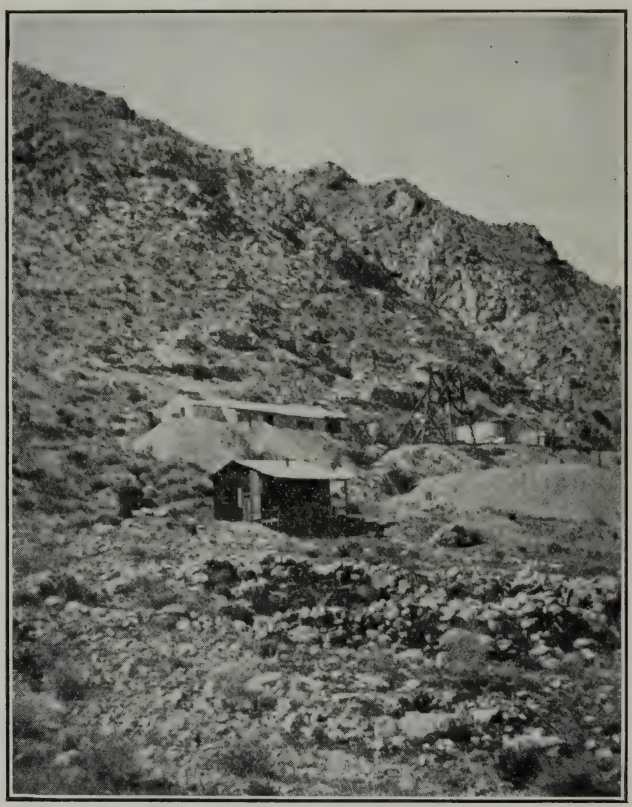
Bibl: State Mineralogist's Report XV, p. 826.

Bonanza King Mine is a well known old producer in the Trojan District of the Providence Mountains. It is on the eastern slope of these mountains, about 25 miles east of Fenner, a station on the Santa Fe Railroad. Elevation 4200 feet. Idle.

For detailed description see Report XVII, pp. 360–361.

Bibl: State Mineralogist's Reports X, p. 532; XIII, p. 606; XV, p. 827; XVII, pp. 360–361; XX, p. 198.

Bray and Bisbee (Rand Silver King Mining Company). This property is in the Randsburg District, adjoining the California Rand Silver and Coyote properties, on the south. It was developed by a 1½-com-



Bonanza King Mine, Trojan Mining District, Providence Range of Mountains, San Bernardino County.

partment shaft, to a depth of approximately 600 feet and by about 5000 feet of drifts and crosscuts distributed between four levels. Some ore was encountered. Idle.

For a detailed description see California State Mining Bureau Bul. 95, pp. 131–132.

Bullion Mine, consisting of 12 claims, is in the Bullion Mining District, on the east slope of the Ivanpah range of mountains, 10 miles north of Cima. It is just east of the New Trail Gold Mine. Elevation 4500 feet. Owner, Joseph Johnson, Cima, California.

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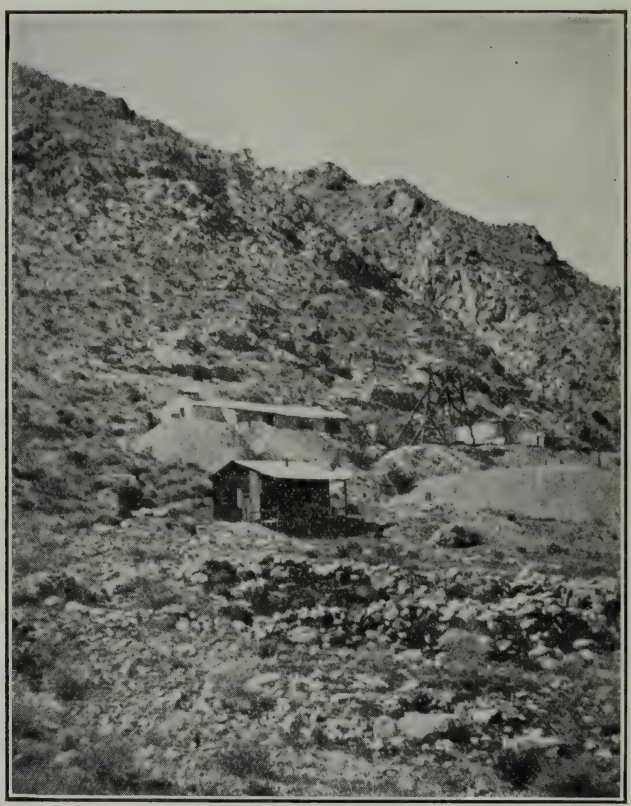
Bonanza King Mine is a well known old producer in the Trojan District of the Providence Mountains. It is on the eastern slope of these mountains, about 25 miles east of Fenner, a station on the Santa Fe Railroad. Elevation 4200 feet. Idle.

For detailed description see Report XVII, pp. 360–361.

Bibl: State Mineralogist's Reports X, p. 532; XIII, p. 606; XV, p. 827; XVII, pp. 360–361; XX, p. 198.

Bray and Bisbee (Rand Silver King Mining Company). This property is in the Randsburg District, adjoining the California Rand Silver and Coyote properties, on the south. It was developed by a 1½-com-



Bonanza King Mine, Trojan Mining District, Providence Range of Mountains, San Bernardino County.

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CLAIM MAP
OF
CALICO MINING DISTRICT
SHOWING CLAIMS THAT HAVE BEEN CONSOLIDATED

SAN BERNARDINO COUNTY CALIF

SCALE
500 0 500 1000 1500 FT

COMPILED BY EDWARD L HAFF
WITH ADDITIONS BY W B TUCKER

DIVISION OF MINES
WALTER W BRADLEY
STATE MINERALOGIST

1930

9 10 11 16 15 14 13 21 22 23 24

NORTH CALICO 6 NORTH CALICO 4 NORTH CALICO 3 NORTH CALICO 2 NORTH CALICO N°1 RED BLUFF 3 RED BLUFF N°2 RED BLUFF N°4 RED BLUFF

STORM CLOUD STORM CLOUD 1 STORM CLOUD 2 STORM CLOUD 3 STORM CLOUD 4 CLARIA M. GREAT NORTHERN 4 GREAT NORTHERN 6 LEXINGTON CALISTOGA ODESSA 2836 BULLION 2899 DANA GIFT GIFT FRACTION HILL TOP SWEET WATER

BIRDS EYE BIRDS EYE N°4 BIRDS EYE 2 BIRDS EYE 3 6062 ARGENTUM 6066 B'S WARK 6067 EUPHRATES BULLION FRACTION 2599 OCCIDENTAL 2739 OCCIDENTAL RUN OVER 2596 RUN OVER RUN OVER N°3 RUN OLER 1-2 RED HILL

RED BLUFF LITTLE SIOUX SIOUX EDGAR LUCKY BOY OLD ORIENTAL WREN GUINEA SWAMP

CALICO MINING CO. — ODESSA — 6062 ARGENTUM 6066 VETO 6067 THUNDERER 6067 YANKEE 6067 GARFIELD N°1 6067 GARFIELD 2595 6067 DRAGON 6067 ALHAMBRA 6067 TRAVELER 6067 LEC 6067 ARGENTUM 3 6067 ARGENTUM 4 6067 ARGENTUM 5 6067 ARGENTUM 6 6067 ARGENTUM 7 6067 ARGENTUM 8 6067 ARGENTUM 9 6067 ARGENTUM 10 6067 ARGENTUM 11 6067 ARGENTUM 12 6067 ARGENTUM 13 6067 ARGENTUM 14 6067 ARGENTUM 15 6067 ARGENTUM 16 6067 ARGENTUM 17 6067 ARGENTUM 18 6067 ARGENTUM 19 6067 ARGENTUM 20 6067 ARGENTUM 21 6067 ARGENTUM 22 6067 ARGENTUM 23 6067 ARGENTUM 24 6067 ARGENTUM 25 6067 ARGENTUM 26 6067 ARGENTUM 27 6067 ARGENTUM 28 6067 ARGENTUM 29 6067 ARGENTUM 30 6067 ARGENTUM 31 6067 ARGENTUM 32 6067 ARGENTUM 33 6067 ARGENTUM 34 6067 ARGENTUM 35 6067 ARGENTUM 36 6067 ARGENTUM 37 6067 ARGENTUM 38 6067 ARGENTUM 39 6067 ARGENTUM 40 6067 ARGENTUM 41 6067 ARGENTUM 42 6067 ARGENTUM 43 6067 ARGENTUM 44 6067 ARGENTUM 45 6067 ARGENTUM 46 6067 ARGENTUM 47 6067 ARGENTUM 48 6067 ARGENTUM 49 6067 ARGENTUM 50 6067 ARGENTUM 51 6067 ARGENTUM 52 6067 ARGENTUM 53 6067 ARGENTUM 54 6067 ARGENTUM 55 6067 ARGENTUM 56 6067 ARGENTUM 57 6067 ARGENTUM 58 6067 ARGENTUM 59 6067 ARGENTUM 60 6067 ARGENTUM 61 6067 ARGENTUM 62 6067 ARGENTUM 63 6067 ARGENTUM 64 6067 ARGENTUM 65 6067 ARGENTUM 66 6067 ARGENTUM 67 6067 ARGENTUM 68 6067 ARGENTUM 69 6067 ARGENTUM 70 6067 ARGENTUM 71 6067 ARGENTUM 72 6067 ARGENTUM 73 6067 ARGENTUM 74 6067 ARGENTUM 75 6067 ARGENTUM 76 6067 ARGENTUM 77 6067 ARGENTUM 78 6067 ARGENTUM 79 6067 ARGENTUM 80 6067 ARGENTUM 81 6067 ARGENTUM 82 6067 ARGENTUM 83 6067 ARGENTUM 84 6067 ARGENTUM 85 6067 ARGENTUM 86 6067 ARGENTUM 87 6067 ARGENTUM 88 6067 ARGENTUM 89 6067 ARGENTUM 90 6067 ARGENTUM 91 6067 ARGENTUM 92 6067 ARGENTUM 93 6067 ARGENTUM 94 6067 ARGENTUM 95 6067 ARGENTUM 96 6067 ARGENTUM 97 6067 ARGENTUM 98 6067 ARGENTUM 99 6067 ARGENTUM 100

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BLACKFOOT GROUP — 3329 BLACK FOOT 2333 BLACK FOOT N°2 BLACK FOOT N°1 BLACK FOOT EXT BLACK FOOT OVERLOOK J R LANE N°1 J R LANE N°2 J R LANE N°3 J R LANE N°4 J R LANE N°5 J R LANE N°6 J R LANE N°7 J R LANE N°8 J R LANE N°9 TRIANGLE

DIETZMANN GROUP — 2766 VOLCANO VIEW 2766 SNOW BIRD BELLEVIEW BELLEVIEW N°2 ALAMEDA RICHMOND 2703 ALABAMA 2703 PARADISE

BURCHAM GROUP — MINESOTA MISSISSIPPI MISSOURI OHIO IOWA WYOMING COLORADO VERMONT NEW MEXICO WISCONSIN TENNESSEE DAKOTA NEBRASKA KENTUCKY INDIANA

LONE STAR GROUP — CONSOLIDATED ST LOUIS 6033 SILVER SPAR 6033 RED CLOUD EXT 2887 BLACK STRAP 6039 RUSE 6039 SILVER CROWN 6039 SILVER CROWN N°2 6039 SILVER CROWN N°3 6039 SILVER CROWN N°4 6039 SILVER CROWN N°5 6039 SILVER CROWN N°6 6039 SILVER CROWN N°7 6039 SILVER CROWN N°8 6039 SILVER CROWN N°9 6039 SILVER CROWN N°10 6039 SILVER CROWN N°11 6039 SILVER CROWN N°12 6039 SILVER CROWN N°13 6039 SILVER CROWN N°14 6039 SILVER CROWN N°15 6039 SILVER CROWN N°16 6039 SILVER CROWN N°17 6039 SILVER CROWN N°18 6039 SILVER CROWN N°19 6039 SILVER CROWN N°20 6039 SILVER CROWN N°21 6039 SILVER CROWN N°22 6039 SILVER CROWN N°23 6039 SILVER CROWN N°24 6039 SILVER CROWN N°25 6039 SILVER CROWN N°26 6039 SILVER CROWN N°27 6039 SILVER CROWN N°28 6039 SILVER CROWN N°29 6039 SILVER CROWN N°30 6039 SILVER CROWN N°31 6039 SILVER CROWN N°32 6039 SILVER CROWN N°33 6039 SILVER CROWN N°34 6039 SILVER CROWN N°35 6039 SILVER CROWN N°36 6039 SILVER CROWN N°37 6039 SILVER CROWN N°38 6039 SILVER CROWN N°39 6039 SILVER CROWN N°40 6039 SILVER CROWN N°41 6039 SILVER CROWN N°42 6039 SILVER CROWN N°43 6039 SILVER CROWN N°44 6039 SILVER CROWN N°45 6039 SILVER CROWN N°46 6039 SILVER CROWN N°47 6039 SILVER CROWN N°48 6039 SILVER CROWN N°49 6039 SILVER CROWN N°50 6039 SILVER CROWN N°51 6039 SILVER CROWN N°52 6039 SILVER CROWN N°53 6039 SILVER CROWN N°54 6039 SILVER CROWN N°55 6039 SILVER CROWN N°56 6039 SILVER CROWN N°57 6039 SILVER CROWN N°58 6039 SILVER CROWN N°59 6039 SILVER CROWN N°60 6039 SILVER CROWN N°61 6039 SILVER CROWN N°62 6039 SILVER CROWN N°63 6039 SILVER CROWN N°64 6039 SILVER CROWN N°65 6039 SILVER CROWN N°66 6039 SILVER CROWN N°67 6039 SILVER CROWN N°68 6039 SILVER CROWN N°69 6039 SILVER CROWN N°70 6039 SILVER CROWN N°71 6039 SILVER CROWN N°72 6039 SILVER CROWN N°73 6039 SILVER CROWN N°74 6039 SILVER CROWN N°75 6039 SILVER CROWN N°76 6039 SILVER CROWN N°77 6039 SILVER CROWN N°78 6039 SILVER CROWN N°79 6039 SILVER CROWN N°80 6039 SILVER CROWN N°81 6039 SILVER CROWN N°82 6039 SILVER CROWN N°83 6039 SILVER CROWN N°84 6039 SILVER CROWN N°85 6039 SILVER CROWN N°86 6039 SILVER CROWN N°87 6039 SILVER CROWN N°88 6039 SILVER CROWN N°89 6039 SILVER CROWN N°90 6039 SILVER CROWN N°91 6039 SILVER CROWN N°92 6039 SILVER CROWN N°93 6039 SILVER CROWN N°94 6039 SILVER CROWN N°95 6039 SILVER CROWN N°96 6039 SILVER CROWN N°97 6039 SILVER CROWN N°98 6039 SILVER CROWN N°99 6039 SILVER CROWN N°100

EMPIRE SILVER LEAD M. CO — EMPIRE COMMONWEALTH CO RAINBOW

Rhyolite Tuff & Breccia — Rhyolite Breccia — Rhyolite Tuff — Sandstone & Clay — Quaternary — Sandstone & Clay — Hornblende — Andesite

To Daggett

T.10N R.1E. S.B.M.

78537—between pages 270-271

It is an old property. The ore consisting of carbonate of lead, carrying silver values, occurs in fractures in the limestone. Development consists of a shaft 150 feet deep. Idle.

Calarivada Mine. (See under Copper.)

Calico-Odessa Group of Mines. This group of mines consists of a number of former producing properties known as the *Baltic, Bismark, Garfield, Odessa* and *Thunderer* groups, consolidated under one ownership, known as the Calico-Odessa Mining Company: J. R. Lane, president; F. J. Dawson, secretary; Ralph Roseberry, vice president and consulting engineer; E. W. Carroll, superintendent. Offices, 612 I. W. Hellman Building, Los Angeles.

The holdings of the company comprise 55 claims, totaling 1000 acres, situated in Secs. 10, 11, 14, 15 and 23, T. 10 N., R. 1 E., S. B. M., in the Calico Mining District, 5 miles northwest of Yermo, a station on the Union Pacific Railroad. Elevation 2500 to 2800 feet.

Bismark Group is situated on the divide between Bismark Canyon and a branch of Wall Street Canyon. The formation is rhyolite tuff. Chlorides and chloro-bromides of silver occurring in irregular fractures and joint planes in a mineralized zone along a fault fissure, known as the Bismark fault, the course of which is N. 17° W., dip 30° W., separates a mass of brown tufa on the west from a light, stratified tufaceous sandstone. The ores of the Bismark Group are cerargyrite and a little chrysocolla, occurring in a gangue of barytes.

Development consists of shaft 100 feet deep and a series of open cuts and tunnels.

Garfield and Thunderer Group is situated on ridge west of Odessa Canyon. The divide between Bismark and Odessa canyons is mainly built up of massive violet-brown liperite. In this liperite occurs a series of ore deposits somewhat different from the Oriental and Silver King ore zones. The ore occurs in fractures and crushed zones of rock, usually cementing the fragments. These zones are connected with a distinct fault plane, known as the Garfield fault. The general course of this fault plane is northwest and southeast. Some ore was found along the main fault but the largest orebodies were on the south side of this fault. The whole forms a zone of irregular fissures in rhyolite tuff. The silver ores occur mainly on these cracks and seams and the whole often appears as a breccia of tuff, cemented by the gangue and argentiferous minerals. The argentiferous minerals are as usual cerargyrite and embolite; also a little chrysocolla, occurring in a gangue of barytes.

Development: At an elevation of 2800 feet is the lower Garfield tunnel which is 4000 feet in length, driven along the Garfield fault. At an elevation of 2900 feet is an upper tunnel about 2500 feet in length. Large chambers of ore were mined through these tunnels on both sides of the fault. These chambers were about 300 feet in length by 40 feet wide.

Odessa Mine is situated on a ridge west of Odessa Canyon, at an elevation of 2700 feet. The orebodies are found in bunches, or pockets, varying from small deposits to large ore chambers. Orebodies occur on intersections of fissures running in all directions through the rock mass. The fissures intersect Odessa fault which strikes N. 40° W.,

and dips 50° SW. Chlorides and chloro-bromides of silver are found along seams and fractures in the rock mass.

Development consists of the Odessa tunnel which is driven 600 feet on the Odessa fault. A number of winzes have been sunk from the tunnel level to depths of 100 feet on the vein. There are six miles of underground workings on the above-mentioned mines.

At the time these properties were visited the company was making a survey of the different underground workings and also compiling a geological map of the area. On the completion of this survey and the map, the most favorable point was to be determined for location of the main working shaft for the exploration of the ore zones in depth.

Several men employed.

California Coeur d'Alene Mining Company's property, consisting of 34 claims, is on the north side of the South Fork of Lytle Creek, on the southeast slope of the San Bernardino Mountains. It is approximately 22 miles northwest of Rialto. Elevation about 4500 feet. Owner, R. D. Foster, Trustee, 671 I. W. Hellman Building, Los Angeles.

The rocks exposed on the south side of the South Fork of Lytle Creek here, are granitic. On this property which is on the north side of the canyon, three beds of crystalline limestone are exposed on the precipitous mountain side. These are separated by from 200 to 400 feet of felsitic intrusives. There is a series of irregular, replacement deposits of unknown extent, along fractures in the felsite, as well as on the limestone contacts. The strike is generally NW.-SE., dip to the east at low angles. Values are in silver, lead and zinc.

Development consists of opencuts, shallow shafts and one 350-foot tunnel, which cut a large flow of water in one of the fractures. No commercial bodies of ore have, as yet, been developed.

Three men are employed doing assessment work.

California Rand Silver Mine is in the Randsburg District, approximately 1½ miles southeast of the town of Randsburg and one-half mile west of Osdick, a station on the Kramer-Johannesburg branch of the Santa Fe Railroad. It originally consisted of 12 claims in Sec. 6, T. 30 S., R. 41 E., M. D. M., but later, as the result of various consolidations, notably that with the Coyote (the Randsburg Silver Mining Company), it either owned or controlled about 70 claims. Owner: Was owned and operated by the California Rand Silver Company until September, 1929, when it was taken over by the *Consolidated Metals Company;* H. W. Klipstein, president; H. W. Gould and Company, Consulting Engineers, 762 Mills Building, San Francisco. Recently reported that *Wortley Consolidated Mines Company* has acquired this property.

By reason of its importance as a producer for several years, this mine was the largest single producer of silver in the United States[1]. Much has been written concerning this property. The reader is referred especially to Bulletin 95 of the California State Mining Bureau, 'Geology and Ore Deposits of the Randsburg Quadrangle,' from which much of the following has been taken.

[1] U. S. G. S. Water Supply Paper 578, p. 30.

On April 12, 1919, Jack Nosser and W. H. Williams discovered the outcrop of a silver-bearing vein on the Juanita claim. Assays from this outcrop gave 300 ounces of silver and 3 ounces of gold per ton. The company was then formed. Initial shipments from a hole on the shaft vein, 17 feet wide by 22 feet long and 75 feet deep, gave returns in excess of $300,000 from the smelter[1].

The first shipment was made on June 15, 1919. On December 15, 1921, a 100-ton flotation plant was put into operation. This was later increased first to 200 tons and then to 400 tons per day. Total production of this mine to date (July, 1930) amounts to approximately $16,000,000, of which about $4,500,000 was paid in dividends. Figures on the actual tonnage from which this total production came are not available. However, to April 1, 1924, the production record was as follows:

Shipping ore: 49,150.70 tons, having an average content of $4.97 in gold and 106.04 ounces of silver per ton. Milling ore: 177,074 tons, average $1.50 in gold and 19.12 ounces of silver per ton. From the Grady lease 18,222.30 tons, which averaged $6.16 in gold and 81.64 ounces of silver per ton. The gross value of this ore was $10,152,666.90.

Some idea as to the value of the ore as mined may be had from the fact that one stope on the Antimony vein, between the seventh and eighth levels, produced 20,084 tons, having an average value of $73.95 per ton, or a total value of $1,485,212. This stope was not over 200 feet long, less than 100 feet high, and it is reported that it is in places 65 feet wide. Also a block of 10,400 tons in the Grady lease, average width of 5 feet, gave returns of $87 per ton, a total of $904,800.

There are two systems of veins in the Rand schist on this property. One system has a NE.-SW. strike, the other N.-S. The dip is to the southeast and east, respectively. Near the surface they dip steeply, but flatten with depth. It was at the junction of these various veins that the larger orebodies were found.

The principal veins worked were the Antimony, Alpha, Footwall, Shaft and Williams of the northeast-southwest series and the Blanck, Frog, Treasure Box, Rourke, Jameson, No. 3 Stope, 518 and 330, Sill, Harrell, Cow Trail, Hughes, Grady Lease, Wark, Unnamed and Nosser veins of the north-south system.

The mine was developed and worked through three principal shafts and approximately nine miles of drifts and crosscuts. No. 1 shaft, inclined at an angle of 73°, is down to the eleventh level, a vertical depth of 661 feet; No. 2, which was the main working shaft, is down to the nineteenth level, a depth of 1442 feet. It is vertical. No. 6 shaft, vertical, is 870 feet deep.

Due to the low price of silver the present operators are doing very little development work. Their work is confined to removing pillars and slabbing the walls of old stopes where the former operators had left ore. Some ore has been developed by following narrow streaks of high grade in the various veins. In this manner a gross production of approximately $40,000 per month has been maintained for some months past. Of this monthly production, 300 to 350 tons averaging $75 (with silver at 45¢ per ounce) is shipped direct to the smelter. About 1500 tons per month is milled, having an average value of $12.

[1] Hulin, C. D., California State Mining Bureau Bull. 95, p. 109.

For history of its development, description of the plant, cost of production and other details, see references.

Bibl: State Mineralogist's Reports XVII, pp. 361–362; XIX, pp. 61, 98, 99, 167; XX, pp. 48, 49, 96; Bull. 95, pp. 110–121.

Carbonate Mine. This old property, in the Oro Grande District, is reported to have shipped 3 cars in 1929, while under lease to W. E. King of Los Angeles. Reported net returns of $35 per ton on these shipments. Idle.

Bibl: State Mineralogist's Reports IX, p. 230; X, p. 527; XI, p. 361; XII, p. 263; XIII, p. 33.

Carbonate Hill Group, consisting of 8 claims, is in the Holcomb Valley District, in the San Bernardino Mountains, 43 miles east of Victorville. Elevation 7500 feet. Idle. For description see

Bibl: State Mineralogist's Report XVII, p. 362.

Carbonate King Mine is about 7 miles southwest of Roach, Nevada, 5 miles west of the Salt Lake City highway, and on the southwest slope of Ivanpah range of mountains. Consists of 6 unpatented claims. Elevation 5500 feet. Owners, M. W. H. Williams, county treasurer, San Bernardino County, and associates.

The mineralization, consisting of oxides of iron and manganese and lead carbonates, carrying silver, occurs along a fracture and in the bedding planes of a dolomitic limestone. Strike of the bedding planes is NW.-SE., dip 45° SW. Fissure strikes N. 20° E., dip vertical. The replacement along bedding planes takes place for a distance of approximately 25 feet each side of the fracture.

Development consists of a tunnel, driven N. 20° E., 500 feet. This tunnel is at the same elevation as the top of the mill. No ore was encountered here. At the face a raise was put up to connect with the workings above. Some 300 feet above is a tunnel driven northeasterly. At 60 feet above the portal a strong fissure was encountered. This was followed for a distance of about 100 feet and stoped to the next tunnel above; also a short drift to the northwest, following the ore in the bedding planes. The upper tunnel is about 150 feet above. It is now an open cut, the ore having been stoped to the surface. It is 100 feet long and 40 feet high at the face. The average width of the ore is from 3 to 4 feet. At the concentrates loading bin, near the top of the surface incline tram, there is a shaft which was sunk to a depth of 112 feet on 45° inclination.

The mill on this property consists of the following: No. 2½ Wheeling jaw crusher to crushed-ore bin; belt feeder to rolls, to double-deck vibrating screen (¼ and 10-mesh); each of the three products from these screens goes to a separate jig; tails from all jigs to waste; hutch product from the two coarse jigs to rolls, to vibrating screen; fines from screen and hutch from fines jig to 3 Overstrom tables; oversize from screen returned to rolls. Water is recovered by means of drag belts. Mill driven by 60-hp. Fairbanks-Morse semi-diesel engine.

A 2-inch pipe line from the old Ivanpah Mine, which is 8 miles south, delivers water by gravity to the mill. Idle.

Cave Springs Mining Corporation (Imperial Lode Mines.) The property of this company is in the Lava Beds District, 9 miles southwest of Lavic, a station on the Santa Fe Railroad. It consists of 3 patented claims, the Morning Star, Mammoth Chief and Desert Queen, and 8 claims held by location. Elevation about 4000 feet. Owner, Cave Springs Mining Corporation; W. W. Tucker, president, 1308½ Valencia street, Los Angeles.

This property is on the Imperial lode. This lode consists of a great branching fissure in quartz porphyry, varying in width from 4 to 18 feet and traceable along a bold outcrop for a distance of 8000 feet. For a description of the veins and old workings see Eleventh Report, pp. 349–354. Present activity is described under Imperial Lode Lease.

Bibl: State Mineralogist's Reports XI, pp. 349–354; XV, pp. 821–822; XVII, pp. 362–363.

Columbia Mine. It comprises 4 claims, situated in the Kelso Mining District, on the southwest slope of the Providence range of mountains, 5 miles southeast of Ames, a station on the Union Pacific Railroad. Elevation 4600 feet. Owner, Mrs. R. P. Greenleaf and V. E. Stockwell, Los Angeles.

Three parallel veins occur in quartz-monzonite; strike N. 70° E., dip 40 to 50° SE. The veins vary in width from 12 inches to 6 feet. The vein quartz is mineralized with pyrite, galena and spalerite, with gold and silver values. The ore is said to carry $4 to $8 per ton in gold, 20 to 53 ounces in silver, with 1 per cent to 3 per cent in zinc.

The property was under lease to J. G. Thorne of Los Angeles during 1926, who shipped 57 tons of ore to the U. S. Smelting, Refining and Mining Company of Salt Lake Utah, which had an average value of $28 per ton in gold and silver.

Developments consist of an incline shaft 320 feet deep, with drifts on the vein on 100, 200 and 300-foot levels. On the 300-foot level there is a crosscut 300 feet south, which cuts a parallel vein. A tunnel has been driven northeast 300 feet on this parallel vein. This vein has an average width of 4 feet and carries values in gold and silver. Some stoping has been done above the tunnel level, also underhand stope below the tunnel level. Recent ore shipments were extracted from this tunnel. Idle.

Bibl: State Mineralogist's Report XVII, p. 340.

Chicken Hawk was a prospect in the Randsburg silver belt.

Bibl: California State Mining Bureau Bull. 95, p. 132.

Commonwealth Group (see Randsburg Associated Mines, Inc.).

Coyote (see Randsburg Silver Mining Co.).

Cuve (see Rand United Mining Co.).

Daggett Reduction Company (see Fifteenth Report, pp. 824–826).

Death Valley Mine, comprising a group of 7 unpatented claims, is 3 miles east of Cima, a station on the Union Pacific Railroad. Elevation 4400 feet. Owner, J. Lee Strawn, Cima, California.

This property was discovered in 1906 by J. L. Bright of Kelso. In July of the same year, the Death Valley Mines Company, a Colorado corporation, took over and operated the mine until the close of 1907, when it became involved in litigation which was not cleared up until 1915. The present owner came into possession of the property at this time. His operations were conducted from 1917 to 1921, when it was shut down, except that the pumps were kept in operation until June 11, 1927. On this date the plant was destroyed by fire and the property has not again been active.

The mine is on a flat at the foot of the northeast slope of the New York Mountains and is easily accessible over a good road.

Two parallel veins have been found on this property. They are approximately 215 feet apart; strike NE-SW., dip 45° SE. The hanging wall is diorite and the footwall is granite. The vein, as stoped, averages 4 feet in width. The ore below 60-foot level is argentite (silver sulphide) with small amount of galena. From surface to 60-foot level, the ore consisted of chloro-bromides of silver.

The property was developed by 2 shafts. The principal one, known as the Death Valley shaft, was sunk on an inclination of 45° to a depth of 400 feet. In the bottom it is wholly in diorite. Levels were driven at 100, 150, 200 and 400 feet. On the 150-foot level there is a drift 400 feet west and 200 feet east; on the 200-foot level there is a drift 300 feet west and one 230 feet east. The ore shoot which was stoped from the 200-foot level to the surface, was 400 feet long and had an average width of 4 feet. On the 400-foot level a crosscut was driven south a distance of 138 feet. A parallel vein 7 feet wide was encountered in this crosscut. Drifts were driven on this vein, east 125 feet and west for the same distance. Average value of this ore was as follows: Gold 0.16 ounces, silver 17 ounces, lead 2.5 per cent, zinc 1.5 per cent, this being the average of 500 tons which was put through the mill. A 10-inch streak on the footwall carried higher values. This ore, sorted out and shipped, averaged gold 1.87 ounces, silver 67 ounces per ton.

Southwest of the Death Valley shaft, a distance of 1500 feet, is the Arcalvada shaft. This shaft was sunk on a 70° incline to a depth of 285 feet. At the 125-foot level there is a drift east 135 feet.

The average grade of the ore shipped from between the 200-foot level and the surface was: Gold 0.18 ounces, silver 75 ounces, lead 2.5 per cent. Average of second grade ore, which was milled: Gold 0.09 ounces, silver 12 ounces. Average grade of the concentrates shipped: Gold 0.23 ounces, silver 110 ounces, 18 to 23 per cent lead and 15 per cent zinc.

Ore reserves now reported as follows: 500 tons on dump, averaging gold 0.10 ounces, silver 17 ounces, lead 1.5 per cent to 2 per cent; 6000 tons of second grade ore broken in the stopes; 2 blocks of ore between the 150- and 200-foot levels, 500 tons, average value, silver 35 ounces, gold 0.12 ounces. Total production to date $131,000, of which the original company produced $93,000 and the present owner $38,000.

The Death Valley shaft makes 45,000 gallons and the Arcalvada 30,000 gallons of water daily.

A concentration plant now on the property consists of the following: A 14-inch by 21-inch Blake type crusher, elevator to Marathon rod

mill; elevated to screens, 10-mesh; oversize returned to mill; screenings to cone classifier; coarse to Isbell concentrator; fines to double deck Deister table. Plant driven by electric motor. Capacity 30 tons per day of 24 hours.

There is a 6-room residence and a well-built camp which will accommodate more than 100 men. Idle.

Ellingford Nipton Group, consisting of 3 claims, is in the Clark Mountain, 10 miles northeast of Valley Wells. Idle.

Bibl: State Mineralogist's Report XX, p. 94.

Flat Tire Group is in the Randsburg District, north of the Big Four property.

It was prospected by the *Southern Mining and Milling Company* to a depth of 1560 feet by a $2\frac{1}{2}$-compartment, vertical shaft. This shaft passed through the Rosamond formation into the schist at a depth of 1200 feet. Some crosscutting was done on the 1530-foot level without disclosing any orebodies of commercial value. Idle.

Bibl: California State Mining Bureau Bull. 95, p. 134.

Fox Lease (see Bull 95, p. 134).

Garfield and *Thunderer Mines* (see Calico-Odessa Mining Co.).

Garfield Lease property is in the silver belt of the Randsburg District, just southeast of the Belcher Extension.

It was prospected by a vertical shaft 300 feet deep, with levels at 85, 200 and 300 feet. Spotted values in gold and silver were encountered in the Footwall vein.

The property was taken over under a working agreement by the *Monarch Rand Mining Company.* Idle.

Bibl: California State Mining Bureau Bull. 95, p. 135.

Grady and Sill Lease was a part of the California Rand Silver Mine. From a small block of ground just south of the original workings of the California Rand Silver Mine, this lease produced $1,599,979.98 before it reverted to the owners.

Bibl: California State Mineralogist's Report XIX, p. 61; State Mining Bureau Bull. 95, pp. 117–118.

Ibex Mine or Arcturas (Lead, silver, zinc). It is in the Black Mountains, 16 miles southwest of Zabriskie and 6 miles north of Saratoga Springs. Elevation 1300 feet. Idle.

Bibl: State Mineralogist's Reports XV, pp. 821–822; XVII, p. 287.

Imperial Lode Mine (see Cave Springs Mining Co.).

Imperial Lode Lease, consisting of one patented claim, the Mammoth Chief, is on the Imperial Lode, in the Lava Bed District. Frank W. Orr, Newberry, California, is the lessor; *Cave Springs Mining Company* is lessee.

The Imperial Lode vein has been described by Storms in Report XI, pp. 351–354.

The old work done on this claim consists of several tunnels. One, near the east end of the claim, was driven 200 feet in a westerly direction on the hanging wall side of the vein. On the other side of the ridge, about 1000 feet west of this work, two tunnels were driven in an easterly direction. These are about 50 feet (vertically) apart. The upper one is in about 200 feet, while the lower one is only 150 feet long. These were also driven on the hanging wall side but in each crosscuts were run to the footwall, exposing 6 feet of broken and groundup quartz. This condition on the footwall side is, no doubt, due to the fact that the felsite dike here faulted the vein. Across the canyon to the west is another short tunnel driven west.

The present operators have confined their work to the footwall side of the vein, where it has been cut by the dike. The lead-silver streak on which this work has been done shows a width, varying from a few inches to 4 feet. The gangue is calcite, barite and some quartz (the last named very subordinate in amount). The mineralization consists of lead carbonates, anglesite, wulfenite and bunches of galena, carrying silver values as high as 60 to 70 ounces. Their work, consists of open cuts and one 15-foot shaft on the ridge between the old tunnels; also a tunnel driven east from a point in the ridge about 50 feet above the upper tunnel of the old workings. This tunnel is now in some 40 feet and shows a high-grade streak from 6 inches to 2 feet wide. It will be continued in an effort to get under the 15-foot shaft, where the greatest width of high grade ore was encountered.

Equipment consists of 20-h. p. Chicago Pneumatic Tool Company semi-diesel engine belted to 10 by 10 National air compressor; 2 jackhammers; blacksmith shop and 3 cabins.

Three men are employed driving the tunnel.

Bibl: State Mineralogist's Report XI, pp. 349–354.

Indian Trail Mine is on the north slope of a spur of the Avawatz Mountain, in T. 18 N., R. 3 E., S. B. M. The property consists of 4 claims, 22 miles northwest of Riggs, a station on the Tonopah and Tidewater Railroad. Elevation 2300 feet. Owners, Indian Trail Mining Company; C. E. Berekhart, president; N. K. Rondell, secretary, Los Angeles.

The mineralization occurs along each wall of a diorite dike. The dike has been intruded between alaskite and andesite porphyry; strike NW.-SE., dip 65° W.

It is developed by 200-foot shaft on 65° inclination. On the 50-foot level there is a drift N. 40° W., 200 feet. At 40 feet from shaft, a crosscut was driven north 27 feet and at 50 feet from the shaft, there is a crosscut south 20 feet.

About 2300 feet east of the camp there is a gold quartz vein. The walls are granite and diorite. Values of $20 per ton in gold are reported across a width of 6 to 8 feet. Idle.

Joburg Divide was a prospect just east of Johannesburg. Idle.

Bibl: California State Mining Bureau Bull. 95, p. 144.

Johannesburg Mining and Milling Company owned and developed the Silver King and Silver Moon properties in the Randsburg silver belt.

Bibl: State Mineralogist's Report XIX, pp. 61–62; Bull. 95, p. 142.

Kelly Mine (see California Rand Silver Co.).

Kelly Rand Extension Mining Company sunk a 625-foot shaft some 1500 feet northwest of the California Rand Silver Company's No. 1 shaft, in the Randsburg silver belt. Idle.

Bibl: California State Mining Bureau Bull. 95, p. 136.

Lead Mountain Mine, consisting of 640 acres, patented in Sec. 36, T. 10 N., R. 1 W., S. B. M. is 5 miles northwest of Yermo. Owner Lewis I. Buck. Under lease to *Pacific Minerals Company, Ltd.,* 337 Tenth street, Richmond, California.

For detailed description of this property see Report XX, pp. 199–200.

An attempt to concentrate this ore with jigs and tables in the company's crushing plant at Barstow is reported to have been unsuccessful. Idle.

Little Jack was a prospect in the Randsburg silver belt. Idle.

Bibl: California State Mining Bureau Bull. 95, p. 144.

Lizzie Bullock, is an old property in the Ivanpah District, about 20 miles northwest of South Ivanpah. Idle.

Bibl: State Mineralogist's Report XV, p. 826.

Lucky Jim Mine, consisting of 5 claims, is in the Old Woman Mountains, T. 1 N., R. 21 E., S. B. M., about 20 miles north of Milligan, a station on the Parker cut-off of the Santa Fe Railway. Elevation about 2700 feet. Owner, E. J. Morath, 521 Walnut street, Long Beach, California. Under lease to F. A. Crampton, on the property.

Quartz vein accompanies a porphyritic dike in granite. As is usual in this type of vein, the lenses are found on either wall of the dike and probably overlap. Strike is N. 65° W., dip about 85° N. The vein is reported to average 4 feet in width. The vein matter is a vitreous quartz. Minerals observed were chlorides and bromides of silver and chalcopyrite. Occurrences of argentite and ruby silver are reported, but none were seen. The principal values are in silver. Shipments aggregating approximately $35,000 in value have been made since the opening in 1911. These shipments of selected ore are reported to have run from 200 to 400 ounces in silver, $3 to $4 gold, 5 per cent copper and 5 per cent lead.

The principal development consists of 500-foot crosscut tunnel, driven north. This tunnel is connected with the surface by means of an old shaft 200 feet deep. Considerable work and some stoping was done from this shaft above the tunnel level. The old workings are no longer accessible. On the tunnel level a drift has been driven west about 200 feet and east for a distance of about 150 feet from the crosscut. At the south end of the crosscut a winze 85 feet deep has been put down. Another winze has been sunk to a depth of 35 feet at a point 150 feet west of the crosscut, and 15 feet west of this winze there is a 100-foot raise. As stoped the ore shoots appear to have been from 75 to 100 feet long.

Equipment consists of a compressor driven by tractor engine; drills; Little Tugger hoist at the 35-foot winze; blacksmith shop; and 3 cabins. A three-mile pipeline brings water to the camp from a spring.

Three men are employed sinking the 35-foot winze. The present operator is directing his efforts toward the development of sufficient ore to warrant the erection of a mill.

Mizpah-Montana Property, comprising 2 fractional claims, is 1½ miles southeast of Randsburg and 1500 feet northwest of the California Rand Silver Company's No. 1 shaft.

It was prospected by a 1½-compartment shaft to a depth of 700 feet and some 1300 feet of horizontal workings.

For detailed description see

Bibl: State Mineralogist's Report XIX, pp. 167–168; Bull. 95, p. 138.

Mizpah-Nevada Property was a prospect on the San Bernardino-Kern County line, 1½ miles southeast of Randsburg.

Bibl: State Mineralogist's Report XIX, p. 168; Bull. 95, p. 138.

Mohawk Mine, consisting of 8 claims, is on the west slope of Mohawk Hill, 24 miles north of Cima, a station on the Union Pacific Railroad. Elevation 4500 feet.

Lead ore, having a total value of $70,000, was shipped from this property in 1917.

Bibl: State Mineralogist's Report XVII, p. 363.

Moon Leasing Company (see Johannesburg Mining and Milling Co.).

Morongo Mine is an old property in the Bear Valley Mining District. It consists of one patented claim and a mill site. It is at Cactus Flat. Elevation 5000 feet. Owner, I. E. Nichols, Building Materials Credit Association, 122 East Seventh street, Los Angeles.

The property is developed by 4 shafts, each about 100 feet deep. These were sunk on an east-west vein, carrying lead-silver ores. Idle.

Bibl: State Mineralogist's Report VIII, p. 503.

Mowry Mines Company (formerly known as *Gladstone Gold Mine* or *Halberg's Gold Mine*), consisting of 12 claims, is in the Lava Bed District, 9 miles southwest of Lavic, a station on The Atchison, Topeka and Santa Fe Railroad. Geographically it is the western extension of the Imperial Lode District. Owner, Mowry Mines Company; Roy M. Mowry, president and general manager; Roy N. Bunker, secretary, 2852 Florence avenue, Huntington Park, California.

The geology and ore bodies of this property have been described by Storms in Report XI, pp. 358–359.

There is some 2200 feet of development work on these claims. Four shafts, none of which are now accessible, are reported to have been put down as follows: No. 1, 85 feet deep; No. 2, 250 feet deep, with levels at the 50, 100, 150 and 250-foot horizons; No. 3, 175 feet deep; No. 4, 100 feet deep. Two tunnels 105 feet and 310 feet long, respectively, with a 50-foot winze in the latter, are also reported. This work, presumably all on the same fissure, is scattered over some 3000 feet of its length.

The present work is in No. 1 shaft. This shaft has a bulkhead in it at the 25-foot level. It is reported that the vein in the bottom is 4 feet

wide and that values in gold, silver and lead average $22.50 per ton. The mineralization consists of copper oxides, cerussite and galena, carrying silver and free gold. On the 35-foot level a drift 20 feet east is reported to show 7 feet of ore in the face.

Equipment consists of 6-inch by 4½-inch Rix air compressor, driven by a gas engine; 4 jackhammers; blacksmith shop and camp.

There is on the ground, but not yet erected, the following milling machinery: Small jaw crusher; No. 3 Herman ball mill, 2 Plat-O tables; 2 classifiers; 2 vibrating screens; 3 Allen cone classifiers; a 44-h.p. Pacific marine semi-diesel engine and a 10-h.p. Fairbanks-Morse gas engine.

The present operators intend to continue the development of ore in their No. 1 shaft and will then erect and operate mill. They expect to obtain a water supply from their No. 2 shaft. At present, they are sinking a well for domestic water supply in the canyon at the camp. Four men are employed.

Bibl: State Mineralogist's Report XI, pp. 358–359.

Myra Queen Group (see Randsburg Associated Mines, Inc.).

Navajo and Swastika Mines (Grady No. 2 and No. 1). See California State Mining Bureau Bull. 95, p. 139.

Odessa Mine (see Calico-Odessa Mining Company).

Oriental Group (see Zenda Mining Company).

Oro Plata Mine, consisting of 7 claims in Secs. 23 and 26, T. 3 N., R. 19 E., S. B. M., is in the Old Woman Mountains, 19 miles north of Milligan, a station on the Parker cut-off of The Atchison, Topeka and Santa Fe Railroad. This property is just south of the Lucky Jim. Owner, A. F. deSteiger, Danby, California.

There is a series of parallel veins associated with quartz-porphyry dikes in granite; strike N. 65° W., dip 65° S. They are from a few inches to 5 feet in thickness. The gangue is a vitreous quartz, mineralized with chloro-bromides of silver, galena and free gold.

Development consists of 4 shafts, 30, 56, 76 and 170 feet deep, respectively, and open cuts distributed over some 1200 feet of length along the vein. Several cars have been shipped with reported net smelter returns of $95 per ton. All of this ore came from within 75 feet of the surface.

Idle, except for assessment work.

Perseverance Mine, comprising 12 claims, is in the Trojan District, 22 miles northwest of Fenner, a station on the Santa Fe Railroad. It is in the Providence range of mountains, northeast of the Bonanza King Mine. Idle.

Bibl: State Mineralogist's Report XVII, pp. 364–365.

Pilot Group (see Frisco Group, under Gold).

Providence Mine, now comprising one claim, is in the Providence Mountains, 7 miles east of Hayden. It adjoins the Frisco Group of gold claims on the south. Elevation 5200 feet. Owner, Pete Thibedeau, on the property; address, Kelso, California.

A shaft was sunk 300 feet on the contact of limestone and diorite, with some drifting on the 100 and 200-foot levels. Sixty-five feet below the collar of the shaft a tunnel was driven east 200 feet and connected with the shaft. Drifts off this tunnel were driven north and south for several hundred feet along a fracture which was filled with gouge. None of this work disclosed any ore.

Equipment consists of 350-cu.ft. Chicago pneumatic air compressor and gas engine hoist.

Idle since 1926.

Rand Contact Property, a prospect in the Randsburg District, just south of the Black Hawk. Idle.

Bibl: State Mineralogist's Report XIX, p. 168; Bull. 95, p. 140.

Rand Mountain Property, a prospect in the Randsburg silver belt, prospected by a vertical shaft 435 feet deep.

Bibl: California State Mining Bureau Bull. 95, p. 140.

Randsburg Associated Mines, Incorporated, held 4 groups of claims in the Randsburg silver belt. These groups were the *North Rand* and *Myra Queen*, north of Red Mountain; the *Silver Queen Group* of 3 claims lying between the Flat Tire and Big Four shafts; and the *Commonwealth Group* of 2 claims lying northeast of the Silver Queen Group.

Bibl: California State Mining Bureau Bull. 95, pp. 140–141.

Randsburg Silver Mining Company (Coyote) was eventually consolidated with the California Rand Silver (see, also, Wortley Consolidated Mines Company for the Santa Fe Mine).

Bibl: California State Mining Bureau Bull. 95, pp. 133–134.

Rand Silver Mining Company (see Bray and Bisbee).

Rand United Mining Company prospected 6 claims in the Randsburg silver belt, through the Mizpah-Montana shaft. Idle.

Bibl: California State Mining Bureau Bull. 95, pp. 134–138.

Santa Fe Mine (see Wortley Consolidated Mines Company).

Silver Basin Mine (see Elkhorn Mining Company, under Gold).

Silver Bell Development Company has 8 claims in the Lava Bed District, 17 miles southeast of Newberry Springs and 29 miles east of Daggett. Owner, Silver Bell Development Company; C. H. Bellamy, president and general manager; Maude Gilmore, secretary, 928 West 101st street, Los Angeles.

The mountain on which these claims are located consist of a series of basic volcanic flows, capped by some 200 feet of rhyolite. They dip to the west at an angle of from 20° to 30°. The separate flows are from 250 to 400 feet thick and the texture varies from vesicular, at the contacts, to granitoid in the center of the thickest flows. These formations are traversed by a series of roughly parallel fault fractures, strike N. 40° W., dip 60° to 80° NE. Seven of these have been found on the property. Where these fractures cross the contacts, the vesicles have

been filled with green and white calcite, forming amygdaloidal beds. These amygdules apparently exist for only a few feet on each side of the fracture. The fault fractures are from 2 to 5 feet wide and are entirely filled with calcite. There is one exception in the case of a vein, strike N. 35° W., dip 80° E. The hanging wall is andesite and the footwall is diorite. This vein is 7 feet wide, the filling consists of 9 inches of red, sticky clay on each wall, 2½ feet of well cemented rhyolite tuff and 3 feet of clay and rhyolite boulders, mixed. The filling suggests that this may be a vent through which the rhyolite capping ascended. Values in gold, silver and lead are reported to exist in these veins but no metallic minerals were observed.

Development consists of a crosscut tunnel, driven south for a distance of 435 feet. At 95 feet from the portal there is a drift 17 feet W. and 67 feet E. At 165 feet from the portal the crosscut connects with a 53-foot shaft from the surface. At this point there is also a drift 15 feet east. At 400 feet from the portal, a 100-foot winze has been sunk on the 'red mud' vein described above. At this depth a small flow of water was encountered.

Equipment consists of Schramm compressor; 3 drills; blacksmith shop; and camp.

A small, experimental mill was erected at Ladd's Road House, 6 miles northwest of the mine. It consists of a 6-inch by 9-inch jaw crusher; ten 20-lb. spring stamps and a service concentrator. Power is furnished by 15-h.p. Universal distillate engine.

Three men are employed sinking winze.

Silver Belle Mining Company prospected 3 claims adjoining the California Rand Silver Company's holdings on the west. Idle.

Bibl: State Mineralogist's Report XIX, p. 169; Bull. 95, p. 141.

Silver Cliff Mine, comprising 19 claims, is in the Lava Bed District, 18 miles east and south of Newberry Springs and 8 miles south of the Needles highway. It is one mile east of the Silver Bell. Owner, Silver Cliff Mining Company; Frank A. Humphrey, president and general manager, Box 4, Newberry, California, or 818 Chester Williams Building, Los Angeles. Main office, 19–20 Dover-Green street, Dover, Delaware.

Here a bed of crystalline limestone, dipping to the south is traversed by a northwest-southeast and a north-south fracture. At their intersection the limestone is badly brecciated. The ore forms along the fractures and in the loosely cemented breccia, at the intersection. Values are in lead and silver but no idea of average values were obtainable, nor could any metallic minerals be identified in the ore.

Development consists of a vertical shaft 376 feet deep and a 150-foot shaft sunk on a 75° incline. These are connected on the 150-foot level. Levels in the 376-foot shaft were driven as follows:

One hundred-foot level—crosscut south 15 feet; 150-foot level—drift W. 35 feet; drift E. 200 feet; 160 feet east of shaft there is a crosscut south 45 feet; north 90 feet to bottom of 150-foot incline; 15 feet south of incline is a drift east 25 feet (all of this work is drifting, part on the NW.-SE. and part on the N.-S. fracture). Two hundred fifty-foot level: crosscut N. 25 feet; drift 6 feet E., 8 feet W. Three hundred fifty-foot level: crosscut 75 feet N. This crosscut is wholly

in andesite, which apparently cuts off the limestone. No vein was encountered on this level.

An 80-foot shaft on Vanadium No. 3 claim, other shallow shafts and short tunnels complete the development work.

A small mill was erected on this property. It consisted of Wheeling jaw crusher; 4-foot by 4-foot Denver Engineering Works ball mill; Atkins classifier; ore flotation cell; 2 service concentrators; one 8-foot and one 4-foot dewatering cone.

Water was obtained through a 2½-inch pipe line from a well in the flat 6 miles north of the mines. Idle.

Silver Giant Property was a prospect on Red Mountain in the Randsburg District. Idle.

Bibl: California State Mining Bureau Bull. 95, pp. 141–142.

Silver Glance Property is on the western slope of Red Mountain in the Randsburg silver belt. It is reported that the Wortley Consolidated Mines Company has taken it over.

Bibl: State Mineralogist's Report XIX, p. 169; Bull. 95, p. 142.

Silver King Property (see Johannesburg Mining and Milling Co.)

Silver King Mine (Olivier-Frank Osborne Company. See Zenda Mining Co.). It is in the Calico District.

Silver King Mine, consisting of 6 claims, is in Clark Mountain, in T. 18 N., R. 13 E., S. B. B., 10 miles northeast of Valley Wells. Idle.

Bibl: State Mineralogist's Report XX, p. 94.

Silver King Mine, consisting of 7 claims, is in the Providence Mountains, about 25 miles northwest of Goffs. It adjoins the Bonanza King on the south. Owner, Jens W. Yonggren, 720 West 59 place, Los Angeles. Under lease to H. E. McKnight, 840 South Flower street, Los Angeles.

It is reported that a shaft has been put down to a depth of 165 feet on this property. Also that this work has disclosed a vein from 4 to 6 feet wide which carries from $10 to $56 per ton in lead, silver and gold. No further information available. Presumably idle.

Silver Lode and Black Water Mines, comprising 4 claims, are in the Resting Springs District, on the northeast slope of the Kingston range of mountains, 17 miles west of Ripley, Nevada. Idle.

Bibl: State Mineralogist's Report XVII, p. 366.

Silver Moon Property (see Johannesburg Mining and Milling Co.).

Silver Queen Group (see Randsburg Associated Mines, Inc.).

Silver Reef District (see Report XV, pp. 828–829).

Silver Rule Mine is in the Resting Springs District on the southwest slope of the Kingston Mountains, 17 miles east of Morrison's Siding on the Tonopah and Tidewater Railroad. It consists of 5 claims at an elevation of 4800 feet. Owner, *Pacific Lead and Silver Co.*, Forman and Clark Building, Los Angeles. Idle.

Bibl: State Mineralogist's Reports XVII, pp. 365–366; XXII, p. 500; XV, p. 104.

Silverton Group, consisting of eleven and a fraction claims, is about 2 miles southwest of the Rand Contact property, in the Randsburg silver belt. Idle.

Bibl: California State Mining Bureau Bull. 95, p. 143.

Snow Storm Mine is in the Clark Mountain District, 12 miles northeast of Valley Wells. It consists of 4 claims. Idle.

Bibl: State Mineralogist's Report XX, p. 94.

Stonewall Mine is in T. 18 S., R. 13 E., S. B. M., in the Clark Mountain District, about 12 miles northeast of Valley Wells. It comprises 15 claims. Was extensively worked from 1881 to 1896. Idle.

Bibl: State Mineralogist's Report XV, p. 826; XX, p. 94.

Tip Top Mine is an old property in the Lava Bed District, just south of the Imperial Lode. It is about 10 miles south of Lavic, a station on the Santa Fe Railroad. It was quite a producer of silver-copper ore forty years ago. Idle.

Bibl: State Mineralogist's Report XI, pp. 354–358.

Total Wreck Mine (Burcham Group). It comprises 15 claims situated in Secs. 15, 16, 21 and 22, T. 10 N., R. 1 E., S. B. M., in the Calico Mining District, 4 miles northwest of Yermo, a station on the Union Pacific Railroad. Elevation 2300 feet. Owner, Mrs. Rosella Burcham, Pasadena, California. Under option to Judge Towhy Estate, Los Angeles; James Horn of Los Angeles, resident manager; M. R. McKay, superintendent.

The mud shales and argillaceous sandstones here lie nearly horizontal and contact with tufaceous breccia or yellow-colored rhyolite on the northwest. There are two veins. One has a course of N. 40° W., dip 70° S. and is known as gold vein. The other vein strikes E. and W., dip 70° S., and is known as the lead vein. The veins are composed principally of coarsely crystallized barytes, with quartz, containing brown iron oxides, lead carbonate, manganese oxide and chloride of silver. The veins vary in width from a thin seam to over 10 feet in width, with an average width of 3 to 4 feet.

Development consists of crosscut tunnel 500 feet long. This tunnel level at 125 feet from the portal cut the lead vein, with drift west on this vein 1300 feet and east 200 feet. The vein has an average width of 4 feet and is said to average 10 per cent lead, 10 ounces in silver, with $2 to $4 per ton in gold. The crosscut tunnel continues in a northerly direction for about 270 feet, where is cuts the contact of the stratified sandstone and tufaceous breccia. On this contact occurs the gold vein, which is an iron-stained brecciated quartz, from 8 inches to 3 feet wide. A drift has been run 400 feet east on this vein. This vein is said to carry from $4 to $8 per ton in gold. About 1500 feet north and at an elevation of 500 feet above the tunnel level, an incline shaft has been sunk on a vein to a depth of 80 feet. This shaft developed an orebody 20 feet in width. The ore is said to carry 10 per cent lead, 4 ounces in silver and $4 per ton in gold. The east and west vein which was cut in the tunnel level has been stoped east to the surface for a distance of 100 feet and for a width of 12 feet.

Shipments of ore made from the above-mentioned workings are said to average $9 per ton in gold, 13 ounces in silver and 36 per cent in lead. Ninety tons of ore had been shipped from the property at the time of visit.

Equipment consists of loading bins; jig-back tram line from upper workings to bin; blacksmith shop and office building.

Four men are employed.

Bibl: State Mineralogist's Reports XI, p. 343; XVII, p. 351.

U. S. Mine is in T. 18 N., R. 13 E., S. B. M., in the Clark Mountain District, 12 miles northeast of Valley Wells and 17 miles northwest of Nipton, Nevada. Holdings consist of 4 claims. Idle.

Bibl: State Mineralogist's Report XX, pp. 94–95.

Valentine Group, consisting of 14 claims, is located on the western slope of Clark Mountain, in T. 17 N., R. 13 E., S. B. M., 5 miles northeast of Valley Wells and 23 miles north of Cima, a station on the Union Pacific Railroad. Elevation 6500 feet. Owner, Louis E. Keiper, Cima, California. Under option to *Pacific Foundation Corporation*; T. J. Howard, president; Albert Whittle, secretary, San Diego, California.

Bibl: State Mineralogist's Report XX, p. 95.

War Eagle Mine is located on the eastern slope of the Lead Mountains in T. 4 N., R. 10 E., S. B. M., 9 miles south of Bagdad, a station on the Santa Fe Railroad.

Property is now controlled by H. LeRoy Blessing, 4992 Melrose avenue, Los Angeles, California. Holdings consist of some 320 acres. Development consists of a 700-foot shaft and some 7000 feet of drifts and crosscuts.

Blessing and his associates plan to reopen this property in the very near future. They are especially interested in the recovery of the molybdenum and vanadium which are associated with the lead.

For full description of the property and development work, see,

Bibl: State Mineralogist's Reports XVII, p. 336; XX, pp. 95–96.

Waterloo Mine. It comprises 9 claims located in the Calico Mining District, in Sec. 16, T. 10 N., R. 1 E., S. B. M., 4 miles northwest of Yermo, a station on the Union Pacific Railroad. Elevation 1900 to 2180 feet. Owner, O. F. Washburn, Anaheim, California. This property was formerly owned and operated by the *Waterloo Mining Company,* Milwaukee, Wisconsin.

The Waterloo and Silver King mines were operated by the above-mentioned company from 1881 to 1896. The principal orebodies occur along the Waterloo fault, which strikes northwest and southeast and dips 40° S. The orebodies mined and developed along this fault were found in bunches to very large chambers of ore from 10 to 80 feet in width. The orebody was 1100 feet in length and extended to a depth of 525 feet. The ore is chlorides and chloro-bromides of silver, in a gangue of barite and jaspery silica.

Development consists of two tunnels, the lower tunnel being 1500 feet in length. Upper tunnel is 290 feet in elevation above lower tunnel and is 600 feet in length. There is also an incline shaft 350 feet deep.

Drifts on vein.

Upper tunnel	600 feet
No. 1 level	650 feet
No. 2 level	500 feet
No. 3 level	690 feet
No. 4 level	200 feet

Idle.

Bibl: State Mineralogist's Reports VIII, p. 498; XI, p. 343; XII, p. 376; XIII, p. 609.

Waterman Mine. It comprises 5 patented claims situated in the Grapevine Mining District, 4 miles north of Barstow. Owner, Mrs. W. M. Waterman, Barstow, California.

The formation in which the vein occurs is a rhyolite tuff. The vein is 4 feet wide.

Development consists of a shaft 350 feet deep. The orebody has been worked for the full length of the Waterman claim. There was a 10-stamp mill on the property and the ore milled is reported to have averaged $20 per ton in silver. The property is reported to have had a production of $4,000,000. There are 40,000 to 60,000 tons of tailings on the property reported to have an average value of 5 ounces in silver.

These tailings are under lease to Cooper Shapley and Charles Hook of Los Angeles, who have installed 125-ton flotation plant to recover the barite in the tailings. The tailings are reported to contain 25 per cent $BaSO_4$. Four men employed.

Bibl: State Mineralogist's Reports X, p. 531; XIII, p. 609.

Wortley Consolidated Mines Company (formerly *Great Western Mining and Milling Co.*). This company owns or controls several groups of claims in the Randsburg silver belt. The most important of these are: The California Rand Silver Company's property (quite recently acquired), the Santa Fe Group and the Silver Glance Group. Below is given a description of the Santa Fe only, for others see under names of the various properties.

The Santa Fe Group comprises 15 claims and is in the town of Osdick, on the Kramer-Johannesburg branch of the Santa Fe Railroad. It adjoins the California Rand Silver property on the northeast. Owner, Wortley Consolidated Mines Company; C. C. Wortley, president, 502 North Brand boulevard, San Fernando, California; A. W. Ham, secretary, Las Vegas, Nevada.

The northeast-southwest and north-south fissures of this district traverse the Rand schist on this property. It is believed by the operators that the Antimony and Williams (?) veins, so extensively worked in the California Rand Silver Mine, have been encountered in their workings. Also a vein which has been called the Schist vein. This latter vein has great width, in places as much as 80 feet. These veins are similar to the veins of the California Rand Silver Mine, in that the schist is mineralized along the two systems of fracturing. Vein filling consists of silicified schist, quartz and brecciated schist, recemented with quartz. The mineralization consists of antimonial sulphides of silver, pyrite, chalcopyrite and stibnite. The widths of the veins vary from about 2 to 80 feet.

The principal development consists of the Santa Fe shaft. This shaft is vertical and is 1200 feet deep. To the 935-foot level it is 1½-compartments, below this level it is 2½-compartments. The Rand schist was first encountered at a depth of approximately 850 feet. Levels were driven at the 935, 1000, 1100 and 1200-foot horizons. The total underground development at this shaft is 7575 feet. The Antimony vein was first encountered on the 935-foot level about 100 feet northwest of the shaft. It crossed the shaft between the 1000 and 1100-foot levels and has been crosscut on each of the levels. Its width varies from 12 to 30 feet. The Schist vein has been crosscut on the 1000, 1100 and 1200-foot levels; it varies from 12 to 80 feet in width, and according to Mr. C. W. Mitchell, E.M., it averages 19.36 ounces of silver and 0.13 ounces of gold.

The amount of development work done on the veins at the various levels is as follows:

Antimony Vein

935-foot level—Crosscut showed a width of 20 feet.
1000-foot level—200 feet of drifting; average width 15 feet.
1100-foot level—225 feet of drifting; average width about 18 feet.
1100-foot level—Raise about 125 feet to 1000-foot level.
1200-foot level—Crosscut showed a width of 38 feet.

Schist Vein

(This vein was encountered on the 1000-foot level.)
1000-foot level—150 feet drifting; average width about 20 feet.
1100-foot level—100 feet drifting; average width about 12 feet.
1200-foot level—200 feet drifting; average width unknown.
Raise about 120 feet from 1200-foot to 1100-foot level.
Raise about 120 feet from 1100-foot to 1000-foot level.

Williams (?) Vein

935-foot level—350 feet drifting.
1000-foot level—100 feet drifting.
(It has not been definitely identified below this level.)

There are several other smaller veins that have been encountered in crosscuts on the various levels.

A drift has been driven some 700 feet southwesterly and an incline raise here put up to hole the bottom of the No. 6 shaft of the California Rand Silver Mine.

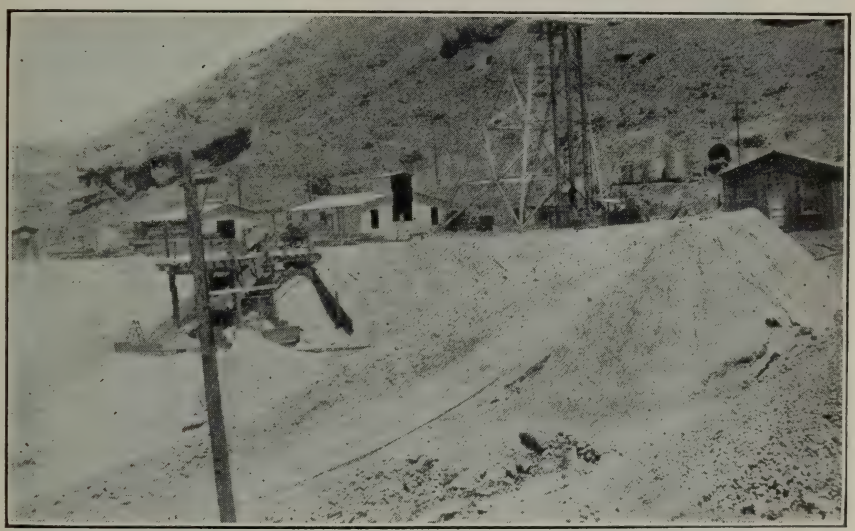
Equipment at the mine consists of 50-h.p. single-drum hoist, motor driven; 12-inch by 10-inch Ingersoll-Rand air compressor, driven by a 60-h.p. motor; 14-inch by 12-inch Chicago pneumatic air compressor, driven by 100-h.p. motor; 3 Byron-Jackson Multiplex pumps, each driven by 30-h.p. motor. The pumps are installed on the 1200, 900 and 600-foot levels; each has a capacity of 200 gallons per minute. There is also a blacksmith shop and assay office.

The mine makes 15,000 gallons of water daily. This water has recently been used in the California Rand Silver Company's mill.

Four men are employed driving a raise from the 1200 to 1100-foot levels.

Zenda Gold Mining Company, T. H. Collins president; W. F. Stanton, secretary; Jack Radcliffe, superintendent. Offices, 517 I. W. Hellman Building, Los Angeles. This company owns the Oriental and Silver King group of mines, comprising 35 claims, situated in Secs. 15 and 22, T. 10 N., R. 1 E., S. B. M., in the Calico Mining District, 3½ miles northwest of Yermo, a station on the Union Pacific Railroad. Elevation 2500 to 2600 feet.

There are two systems of veins on the property known as the Oriental and Silver King fissures, which occur in rhyolite tuff, along what is known as the Kings system of fault fractures. The Oriental vein intersects the Silver King vein near the southeast corner of the Silver King claim. The vein system strikes northwest and southeast and dips 70° SW. Towards the southern end of the system considerable faulting has followed the fracturing, while at the northern end of the system the deposits occur as typical fissure veins with well-developed walls.



Steel headframe and hoist house of No. 2 shaft. Zenda Gold Mining Company, Calico, San Bernardino County.

Along this system of fault fractures the crushing of the rock and faulting reached its maximum on the Red Cloud and Red Jacket claims. Here the rhyolite tuff is in places completely disintegrated and brecciated; and barite and jasper are deposited in cracks and seams, running in all directions through the brecciated mass. The main ore deposits are connected with the main fault planes.

On the Silver King vein the dislocations have been large, resulting in step-faults with successively smaller throw. The ores found along these fissures are all similar in character. A gangue of barite and jaspery silica encloses more or less regularly chlorides and chlorobromides of silver. The cerargyrite and embolite mostly occur as thin coatings in joints and cracks, but also often embedded in the barite. The ore shoots are irregular and occur along the fault fissures, forming orebodies 20 to 50 feet in width. The Silver King vein system was formerly worked through an incline shaft 500 feet in depth, also

opened by a series of crosscut tunnels from the Oriental Mine on the fourth, sixth, seventh, eighth and ninth levels. There are about 6000 feet of drifts and crosscuts on the vein system.

The King and Waterloo mines were operated from 1883 to 1893 by the *Waterloo Mining Company.* In 1893 operations were suspended when silver declined to 78 cents per ounce. From 1883 to 1886, the mines produced 37,000 tons of ore, having a gross value of $1,355,000 or $36.61 per ton in silver; paid dividends of $450,000 or $12.16 per ton. Tailings loss was $7.32 per ton. Operating expense was $17.13 per ton.

The property was acquired in the latter part of 1926 by the Zenda Gold Mining Company. This company put down two diamond drill holes; one, an incline hole, to a depth of 315 feet, which cut the Oriental vein. This hole is said to have cut 18 feet of ore with an average value of 8 ounces. The other was a vertical hole 500 feet in depth which encountered the Oriental vein at 455 feet and is stated to have cut 30 feet of ore having an average value of 15 ounces in silver.

From information obtained from these drill holes, No. 1 shaft was sunk to a vertical depth of 340 feet on the southeast end of Wall Street claim. On the 320-foot level a crosscut was driven northeast, in which it is stated 20 to 40 feet of ore was encountered, with an average value of 40 ounces in silver. Occasional bunches of sulphide ore were encountered on this level, showing chalcopyrite, tetrahedrite and pyrite, with high values in silver. Water was encountered at a depth of 300 feet, the flow being so great that pumps had to be installed. The present flow is 200 gallons per minute. In June, 1929, they started to sink a new 3-compartment shaft (4 feet by 6½ feet) (4 feet by 6½ feet) (4 feet by 4½ feet), which is located on the Oregon claim 547 feet southeast of No. 1 shaft. This shaft which is known as No. 2 shaft, was sunk to a vertical depth of 550 feet. Drifts and crosscuts have been driven on the 320, 430 and 530-foot levels. The total amount of development from No. 2 shaft consists of 12,000 feet of crosscuts and drifts on the above-mentioned levels. Three crosscuts are being driven northeast on the 530-foot level to intersect the King vein. A drift on the 240-foot level connects with workings from No. 1 shaft.

The new development work has determined the present water level of the district and with the discovery of high grade bunches of ore on the 320-, 430- and 530-foot levels, mineralized with chalcopyrite, tetrahedrite and pyrite, indicates the possibilities of finding sulphide orebodies at greater depths on the King and Oriental vein systems.

The ore developed on the above-mentioned levels is stated to carry from 10 to 40 ounces per ton in silver, with some high-grade bunches carrying appreciable values in copper, with assays as high as 1000 ounces per ton in silver.

Mine equipment: Steel headframe, double-drum electric hoist, driven by 75-h.p. motor capable of hoisting to a depth of 4000 feet; 476-cubic-foot Ingersoll-Rand compressor, driven by 100-h.p. motor; Aldridge triplex pump, driven by 75-h.p. motor, capacity 500 gallons per minute; Pomona electric pump; blacksmith and machine shops.

Forty-seven men are employed.

Bibl: State Mineralogist's Reports VIII, pp. 491–498; IX, p. 224; X, p. 530; XI, pp. 337–344; XII, p. 376; XIII, pp. 606–607; XVII, pp. 359-366; Trans. Am. Inst. of Min. Engrs., Vol. XV, p. 718.

TUNGSTEN

Much information regarding the various tungsten districts in San Bernardino County may be found in Report XV, pp. 830–849. Also, regarding the Atolia District, reference should be made to California State Mining Bureau Bulletin 95.

Steel headframe. Union shaft. Atolia Mining Company, Atolia, San Bernardino County.

Argosy Mine, consisting of 3 claims, is in the Signal District, 6 miles north of Goffs.

The ore consists of fine crystals of wolframite, disseminated in a system of veinlets in a pegmatite dike.

Bibl: State Mineralogist's Report XV, pp. 844–845.

Atolia Mining Company. This property, consisting of some 60 patented claims, is approximately 3 miles southeast of Randsburg, on

the Kramer-Johannesburg branch of The Atchison, Topeka and Santa Fe Railroad. Elevation 3200 feet. Owner, Atolia Mining Company; A. V. Udell, president and general manager; F. W. Bradley, vice president, 1022 Crocker Building, San Francisco, California.

Description of the district and its development through the year 1924 is contained in Reports XV and XVII and Bulletin 95 (see bibliography below).

The present work is confined to the Papoose, the ground between the Spanish shaft of the Par Mine and the Flat Iron, the Union Mine and the 'Spud Patch.'

The Papoose is under lease to Mr. Geo. Rust, who has reopened the old shaft to a depth of 400 feet. At present he is removing the fill from old stopes and will later look for extension of the orebody which was lost in the old workings. Drifts on the second and third levels have been opened as follows:

Second level 135 feet west of shaft and 65 feet east.

Third level 80 feet west of shaft and 40 feet east.

The filling is sorted, yielding about one ton of ore to 10 tons of material.

A section of ground between the Par Mine and the Flat Iron has been leased to E. H. Hughes, of Randsburg. A shaft has been sunk to a depth of 56 feet on a vein, the strike of which is east-west, dip 80° to the north. This shaft is 200 feet west of the Spanish shaft. This is the same vein as that worked to the east of the Spanish shaft but was apparently lost on the west side. At the bottom of the shaft, there is a drift east 25 feet and west 21 feet. This has developed an ore shoot 45 feet long, having an average width of 12 inches.

At the Union Mine a winze has been sunk from the 1000 to the 1200-foot level and the shaft was raised on a steeper inclination than that between the 700- and 1000-foot levels; the dip of the vein being greater here. In doing this work, an ore shoot 100 feet long by an average width of 3 feet, was developed. The average grade of the ore in this shoot is about 0.75 per cent WO_3. It rakes to the east at an angle of about 55°. A stope has been started just west of the winze on the 1100-foot level.

The Spud Patch diggings now consist of a roughly circular pit about 500 feet in diameter, by an average depth of 15 feet. This pit will be lengthened in a northwesterly direction. There are at least two and probably more, channels in this area. After the present surface cut is made, these channels will be worked separately to greater depths. The placer is known to extend to the Papoose shaft, a distance of approximately 2000 feet, in a northwesterly direction from the present pit face.

The material is loaded into trucks by an Erie G A-2 gasoline shovel, having a one-cubic-yard dipper.

The mill to treat this placer material was built in 1926. It has a capacity of 750 tons in 24 hours and consists of the following equipment:

Trommel screen 4-feet by 10-feet, 2-inch round openings. It is fitted with a shaft through its center, to which twelve 12-pound hammers are attached by chains. This shaft travels at 350 r.p.m.; the hammers knock all loose material from the boulders which go to waste. The screenings go to 4 Harz jigs, thence to 2 Overstrom tables. The tail-

ings go to 4 dewatering drag belts, thence to 18-inch belt tailings stacker. This stacker is set on a slope of 3½ inches per foot. The stacker dumps on a 16-inch belt conveyor 20 feet long, pivoted so that its outer end swings through an arc of about 300°. Tailings are discharged at 12 per cent moisture. Material treated averages 1.75 pounds concentrates, containing 60 per cent WO_3 per ton.

The No. 1 (or Rust) mill was built at the Union Mine in 1927 and rebuilt in 1928. It was built by the Atolia Mining Company for the Rust Leasing Company. The Atolia Company took it over in September, 1928, upon the expiration of the Rust lease. The mill has a capacity of 130 tons per day and is working on ores from the Union Mine and various dumps on the company's property; also treating ores from the two leasers mentioned above.

Ores at the dumps are loaded into trucks by power shovels. Ore from the Union Mine is hoisted in 2250-pound skips. Material passes over bar grizzly, 3-inch opening; oversize to 24-inch sorting belt; waste to 16-inch belt tailings stacker; ore to storage bin; undersize to storage bin. From the bin it is fed by reciprocating feeder to 24-inch belt conveyor equipped with Ding's magnetic pulley; to 10-inch by 16-inch Hercules jaw crusher, crushing to 2 inches; elevated to Hummer screen; screenings to bin and oversize, by 14-inch belt conveyor to Symons 3-foot cone crusher, in closed circuit with Hummer screen, by means of elevator. The capacity of this crushing plant is 15 tons per hour, from 2 inches to ¼ inch.

Elevated from bin to vibrating screen oversize to Harz jig; undersize and hutch product from jig to Wilfley No. 4 and Overstrom tables; tailings to dewatering drag belts and 16-inch belt stackers. Slimes are settled in surface ponds. Concentrates are retreated in a plant which is described in Report XVII, pp. 370–372.

The dump ores average 5.75 pounds of concentrates containing 60 per cent WO_3 per ton. The mine ores vary somewhat but average about 18 pounds of 60 per cent WO_3 concentrates per ton.

Water for milling operations has been developed in the flat, 7 miles northeast of the placer mill. First a well 400 feet deep was put down. This well is 3½ miles northeast of the placer diggings. It produced only 16,000 gallons daily. They then moved 3½ miles farther northeast and nearer to the dry lake put down a 12-inch hole to a depth of 200 feet. Water is pumped from 115-foot depth by a Pomona turbine pump, driven by a 40-h.p. semi-diesel engine. Pumping from this well at the rate of 125,000 gallons daily does not lower the level of the water. The Pomona pump delivers to a tank at the No. 1 well, 3½ miles away. A Deane Triplex pump, motor driven, forces it the remaining 3½ miles.

It is now reported (July, 1930) that this property is temporarily idle.

Bibl: State Mineralogist's Reports XV, pp. 830–839; XVII, pp. 370–372; XX, pp. 96–97; Bull. 95, pp. 70–78 and 125–128.

Black Hawk Tungsten Mine, comprising 5 claims, is in the Atolia District, one mile west of the town of Atolia. These claims are the Leonard and Halloran groups. Owner, Black Hawk Tungsten Mines Corporation; M. L. Conroy, president, 527 Front street, San Pedro, California. Idle.

Bibl: State Mineralogist's Report XVII, pp. 372–373.

Buckeye Tungsten Mine, consisting of 3 claims, is 1½ miles west by north from Atolia. It is north of the Black Hawk Mine. Elevation 3400 feet. Owner, Buckeye Tungsten Company; C. C. Ray, president; W. W. Keeling, secretary, Atolia, California. Idle.

Bibl: State Mineralogist's Report XVII, p. 373.

Carbonate Group of 6 claims is located in Cliff Canyon, on the north slope of the New York Mountains, 2 miles southeast of Brant, a station on the Union Pacific Railroad. Idle.

Bibl: State Mineralogist's Report XV, p. 841.

Federal Company's Group (formerly *Raynor Group*), composed of 10 claims and fractions, is in Secs. 19 and 20, T. 30 S., R. 41 E., M. D. M. Owner, J. C. Raynor, Atolia, California.

The claims are: Federal Reserve, Ready Cash, Federal, Paymaster, Trade Dollar, Uncle Sam, Trade Dollar Extension, Wonder, Old Glory and Wedge Fraction, comprising 160 acres.

Development on the Federal claim consists of two shafts, 240 feet and 50 feet deep, respectively. On the 240-foot level there is 160 feet of drifts; on the 100-foot level, 100 feet cross-cutting and 160 feet drifting. The vein is from 2 to 5 feet in width. There is a reported production of $30,000 from these two shafts.

On the Trade Dollar and Trade Dollar Extension there are several shallow shafts, maximum depth of 60 feet. Several of these are connected by stopes which have been worked up to within 15 feet of the surface.

One man employed on assessment work.

Gustave Group is south of Atolia on west side of railroad. Idle.

Bibl: State Mineralogist's Report XV, p. 837.

Irish Group of claims is in the Signal District, 10 miles south of Goffs. Owner, A. A. Irish, Grosse Building, Los Angeles.

Idle except for assessment work.

Bibl: State Mineralogist's Report XV, pp. 846–847.

Leonard and Halloran Groups (see Black Hawk Tungsten Mine).

Lombard and Main Group (formerly *California Vanadium Company*) is in the Signal District, about 8 miles north of Goffs. Idle.

Bibl: State Mineralogist's Report XV, pp. 845–846.

Mojave Annex Tungsten Mine is on the north slope of the New York Mountains, 2 miles southeast of Brant, a station on the Union Pacific Railroad. Idle.

Bibl: State Mineralogist's Report XVII, pp. 373–374.

Mojave Tungsten Mine, now consisting of 2 claims, is in the Clark Mountain District, about one mile south of the Colosseum gold mine. Owner, *Colosseum Gold Mines Corporation.*

Idle except for assessment work.

Bibl: State Mineralogist's Report XV, p. 839.

Nieto Placer Group is in the Atolia District just south of the Union Mine of the Atolia Mining Company. It consists of 3 placer claims,

the Trinity, Triplex and Duplex, in Sec. 30, T. 30 S., R. 41 E., M. D. M., comprising 320 acres. Owner, John Nieto, Seaside Terrace, Santa Monica, California.

Many pits have been dug on this property and a large portion of the surface has been 'turned' by hand. This work was done by leasers who were looking for spuds. It is reported that good wages were made when the price of tungsten was $20 or more per unit.

The average depth to bedrock is 15 feet to 18 feet. While spuds may be found distributed throughout this depth, the real pay streak is reported to consist of from 6 to 24 inches of material on bedrock. This streak is not continuous, but lies in basin-like depressions.

Two shafts, each approximately 100 feet deep, have been sunk on ledges which cross the property. No ore of commercial value was encountered.

While this property is now idle, it is reported that an improvement in the tungsten market will result in the systematic development of this ground.

Osdick Group is in the Atolia District. It adjoins the Atolia Mining Company's property on the east. Owner, P. J. Osdick, Atolia, California.

This property produced some very high grade ore in 1916. Considerable development work was done at that time.

Bibl: State Mineralogist's Report XV, pp. 837–838.

Reynolds Custom Mill was erected at Goffs in 1916. It is now idle.

Bibl: State Mineralogist's Report XV, pp. 847–848.

Treasury Group is in the Atolia District adjoining the Atolia and Osdick groups on the south. Idle.

Bibl: State Mineralogist's Report XV, p. 839.

Tungsten King Group is on the south slope of the New York Mountains and about 9 miles east of Cima, a station on the Union Pacific Railroad. Elevation 6700 feet. Idle.

Bibl: State Mineralogist's Report XV, pp. 842–843.

United Tungsten Copper Mines are in the Morongo District, on the eastern slope of the San Bernardino Mountains, 50 miles southeast of Victorville. Elevation 6800 feet. Idle.

Bibl: State Mineralogist's Report XVII, p. 374.

VANADIUM

Occurrences of this metal have been found at Camp Signal, near Goffs, and two companies at one time did considerable development work in the endeavor to open up orebodies of commercial quantities. Each had a small mill in operation in 1916, but no commercial output was made. Ore carrying the mineral, cuprodescloizite, was developed and reported to assay 4 per cent V_2O_5. Vanadium occurs in the form of lead vanadate in the Gold Park District near Twenty-nine Palms, near the boundary line between Riverside and San Bernardino counties.

Vanadium occurs at the *Louisiana-California Mine* as a coating along seams in the quartz vein in the form of cuprodescloizite. The occurrence is also noted 4 miles northeast of Kleinfelter, a station on the Santa Fe Railroad, on the *Vanadium King Mine,* owned by W. F. Chausse of Goffs, California. The ore is in the form of a vanadinite. Reported to carry 3 per cent V_2O_5.

Bibl: State Mineralogist's Reports XV, pp. 849–852; XVII, p. 374.

NONMETALLIC MINERALS

The rapid growth of the city of Los Angeles in recent years, has been the incentive for the establishment of industrial plants in the close vicinity of Los Angeles, which in turn has caused an increased demand for both industrial and structural materials. San Bernardino County has a great variety of commercial minerals, some of which are being used by industrial plants in Los Angeles, and a considerable tonnage of both industrial and structural materials are shipped to the manufacturing centers along the Pacific Coast.

The possibilities of the development of the 'industrial materials' are large and with increasing transportation and other facilities, together with the steadily growing demands, the future for this branch of the mineral industry in California is promising. The more important of these minerals thus far exploited as shown by output are: Barytes, clay, feldspar, fuller's earth, gems, lime, limestone, mineral water, miscellaneous stone, silica and talc. Cement is the most important single structural material in the mineral output of San Bernardino County. Three plants operating in the county during the year, 1929, made a total of 3,576,005 barrels, valued at $4,603,301.

The most important development in recent years has been in the discovery and development of barite and bentonite deposits in the desert regions of the county. The increasing demand for barite for use in heavy-gravity, oil-well drilling mud, led to the shipment of a considerable tonnage of this material during the year, 1929. The increased demand for colloidal clay of the bentonite class in place of true fuller's earth, because of its being utilized for clarifying, filtering and cleansing purposes, most of it in petroleum refining, has led to the development of a number of important deposits in the vicinity of Barstow, Daggett and Ludlow. There was a large increase in both amount and value in the output of this material during 1929.

ASBESTOS

Deposits of asbestos, of the amphibole variety occur in the desert regions of the county, but so far no deposits of commercial value have been developed.

Cronese Asbestos Deposit. It comprises a group of 4 claims, situated 10 miles south of Baker and 4½ miles east of Soda, a station on the Tonopah and Tidewater Railroad. Owner, A. B. McAntire, Los Angeles, and Elmo Proctor, Yermo, California.

It is reported that both the chrysotile and amphibole varieties of asbestos occur in a belt of serpentine. Undeveloped.

Hicks Asbestos Deposits. This deposit is situated in the southern portion of T. 9 N., R. 4 W., S. B. M., 4 miles west of Hicks, a station on the Santa Fe Railroad.

The amphibole variety of asbestos occurs in a belt of serpentine which strikes northwest and southeast. The deposit is not of sufficient extent to be of commercial importance. Undeveloped.

Bibl: State Mineralogist's Reports IX, p. 236; XV, p. 852; Bull. 38, p. 263.

BARITE

Barium Queen Mine, consisting of 3 claims, is 5 miles northeast of Barstow, in T. 10 N., R. 1 W., S. B. M. It is on the south slope of a low range of hills, north of the Mojave River. Elevation 3000 feet. Owner, Ellis Mallery, 214 H. W. Hellman Building, Los Angeles.

A series of parallel veins occur in quartzite and schist; strike N. 30° W., dip 70° NE. The main vein, which can be traced on the surface for 4500 feet, is from 4 to 5 feet wide. The barite is white but is slightly iron-stained near the outcrop. The only gangue mineral is reported to be silica.

Development consists of a 250-foot tunnel and 6 shallow shafts, ranging from 20 to 60 feet deep. About 20 cars have been shipped. Used for conditioning oil-well mud. Idle.

Bibl: State Mineralogist's Report XVII, p. 334.

Big Medicine Barite Deposit is 6 miles northeast of Barstow and 1½ miles south of Lead Mountain. Owners, George Parks and Dr. Smith, Barstow, California. Under lease to J. B. Walker, Barstow, California.

On the the northeast slope of a range of hills, a vein has been exposed by means of a small open cut; strike N. 45° W., dip 30° NE. It shows here a width of 4 to 6 feet and is filled with barite, which is iron-stained. Part of the barite is very coarsely crystalline but shades into the finer crystals in a schistose gangue. Some 1500 feet northeast of this work, considerable open cut work has been done on a vein of the same general character. The strike appears to be northeast, dipping flatly (about 20°) to the southeast. Here the vein as exposed in an open cut is about 8 feet wide. The barite is very finely crystalline and so banded as to give it the appearance of a gneissoid rock. The hanging wall is a finely-crystalline, dolomitic limestone, but the footwall has not been exposed. Some road-building has been done with a power shovel and much of the vein is exposed in this manner. There is an open cut 50 feet long, 20 feet wide and 15 feet high at the face; of this height about 9 feet is overburden. Apparently, the cut has just reached the vein at its face. It is reported that this vein carries gold, silver and lead in the barite and quartz gangue.

Mr. Walker reports that he expects to build a concentrator to treat the ore, which is reported to be of chemical grade and is to be sold for this purpose.

Foshay Pass Deposit is located in Foshay Pass, 26 miles southeast of Kelso, a station on the Union Pacific Railroad. Idle.

Bibl: State Mineralogist's Report XVII, p. 334.

Hansen Deposit, consisting of 4 claims, is 3½ miles north of Ludlow. Owners, Harry B. Hansen, Ludlow, California. Under lease to H. A. Hukill, Ludlow, California.

Here a vein from 3 to 14 feet in width (average about 6 feet); strike N. 45° W., dip 45° NE., occurs in a basaltic formation. Vein filling is barite and iron oxide. In places, it is banded with brecciated wall rock, recemented by the barite. This main vein apparently forms a junction with a vein, which on the surface is in the hanging wall and dips 45° to the west. The ore shoot formed along this junction. The shoot is 150 feet long and varies from 3 to 14 feet in width and has been stoped for a depth of 60 feet along its entire length.

Developed by a tunnel 60 feet below the outcrop. This tunnel was driven in a northwesterly direction a distance of 250 feet and stoped as noted above. At the north end of the present workings, the vein has been faulted to the east a distance of 8 feet. It here shows an open watercourse. The owner has shipped 58 cars and the present operators, 2 cars from this deposit. Three men are employed in removing pillars from old stope.

Bibl: State Mineralogist's Report XXVI, pp. 54-55.

Lead Mountain Mine (Barite and lead. See under Silver-Lead.) It is situated in the Grapevine Mining District, in Sec. 36, T. 10 N., R. 1 W., S. B. M., 6 miles north of Barstow. Holdings comprise 640 acres. Owner, Lewis T. Buck, Los Angeles. Under lease to *Pacific Minerals Company;* K. A. Williams, president, Los Angeles.

The country rock is tuff, limestone and andesitic porphyry, the ore-bearing fissure strikes northwest and southeast and dips 40° NE. The width of the ore zone is about 100 feet and has been exposed for a distance of 1300 feet. The vein material is coarsely crystallized barytes, with quartz containing brown iron-oxides, galena, lead carbonate, manganese oxides and silver chlorides.

Development: West of the old workings and at a lower elevation, a crosscut tunnel has been driven north 150 feet crosscutting the vein, with drifts northwest and southeast. The ore being mined from this level is trammed out to ore bins, from which it is loaded into trucks and hauled to the company's grinding and concentrating plant at Barstow. About 20 tons of crude ore is being mined per day. The ore is concentrated in Hancock jigs, producing a product having a high barite content.

Equipment at mine consists of 8-inch by 8-inch Ingersoll-Rand compressor. Twelve men are employed at mine and mill.

Bibl: State Mineralogist's Report XX, pp. 199-200.

Mansfield Deposit. It is situated six miles north of Barstow. Idle.

Bibl: State Mineralogist's Reports XV, p. 853; XVII, p. 334.

Massen Deposit. It is 2 miles southeast of Afton, a station on the Union Pacific Railroad.

Stringers of barite occur on contact of limestone and schist. Idle.

Bibl: State Mineralogist's Report XVII, p. 334.

Pierce Deposit. It is 12 miles east of Victorville. Barite occurs as filling in east-west fractures in the limestone. Idle.

Bibl: State Mineralogist's Report XVII, p. 334.

Pluth Deposit. It is situated 4 miles north of Daggett. Owner, Marcus Pluth, of Los Angeles. The vein is 4 feet wide, filled with white barite, free from iron. Idle.

Bibl: State Mineralogist's Report XVII, p. 334.

Waterman Mine Tailings. These tailings are located on the Waterman Ranch, 4 miles north of Barstow. Owner, Mrs. W. M. Waterman, Barstow, California. Under lease to Cooper Shapley, Bishop, California.

The estimated tonnage contained in this mill tailings dump is said to be 50,000 tons averaging 23% $BaSO_4$, with 3 ounces per ton in silver. A flotation plant having a capacity of 100 tons has been installed on the property.

The equipment consists of one 12-foot K and K Rougher cell, and one 9-foot K and K cleaner cell.

The product produced amounts to 20 tons of barite concentrates per 24-hour day. The concentrate produced has a specific gravity of 4.3 and carries 3 ounces in silver per ton. A recovery of 95% is reported. The concentrate is being shipped for oil-well mud.

Mr. Shapley also has an option on the old Waterloo Mining Company's tailings at Daggett.

Six men are employed.

Bibl: State Mineralogist's Report XXVI, p. 55.

CLAY

Deposits of high-grade clay occur at a number of localities in the county. A plastic kaolin of exceptional quality has been developed on a number of deposits in the Hart Mountains. Common clays are sufficiently abundant in the vicinity of San Bernardino for the manufacture of common brick to supply the local demand. The output of clay for 1928 amounted to 2190 tons, valued at $12,215, which was used in the manufacture of floor and roofing tile, pottery and refractories.

Bibl: Bull. 38, pp. 226–227, 253–254; Prel. Rept. 7, pp. 92–93; Bull. 99, pp. 193–199; State Mineralogist's Report XV, pp. 861–862.

Coors Kaolin Deposit. The property consists of 7½ claims, situated in Secs. 13 and 24, T. 14 N., R. 17 E., S. B. M., at Hart. Elevation 5500 feet. Owner, H. F. Coors, Inglewood, California.

The beds of clay have a thickness of 20 to 25 feet. The clay is a white-burning ball clay, possessing the properties of china clay and ball clay.

Developments consist of a trench 150 feet long, 8 feet deep and 15 feet wide, and two tunnels 70 and 100 feet in length. The clay is shipped to a plant located at Inglewood. Six men are employed.

Bibl: Bull. 99, pp. 194–195.

Gladding, McBean and Company's Clay Deposit. The deposit is situated 4 miles northeast of Bryman, a station on the Santa Fe Railroad, between Victorville and Barstow.

The clay bed has a thickness of 40 feet. The clay is a buff burning clay, which is mined and shipped to the company's plant in Los Angeles for use in the manufacture of face brick.

Development consists of an open cut 40 feet wide and 100 feet long. The production amounts to 150 tons per year.

Bibl: Bull. 99, p. 195.

Holliman and Murphy Clay Deposit. It comprises a group of 12 claims situated in Sec. 14, T. 12 N., R. 14 E., S. B. M., 7 miles southeast of Cima. Owners, R. H. Holliman and D. Murphy, Cima, California.

There are three distinct beds of white, semi-plastic clay, each of which is from 6 to 15 feet thick and can be traced along their strike for 2000 feet. Development consists of shafts and tunnels. Idle.

Bibl.: Bull. 99, p. 195.

Le Feure Clay Deposit. It comprises 24 claims located in Sec. 26, T. 6 N., R. 14 E., S. B. M., 16 miles east of Amboy. Owner, C. B. Le Feure, Los Angeles.

The clay beds have a thickness of 14 feet. The clay is stated to have medicinal qualities. Developments consist of open cuts.

Chemical analysis by Arthur Mass, of Los Angeles:

SiO_2	30.9 per cent
Al_2O_3	23.1 per cent
CaO	21.1 per cent
$CaCo_3$	37.7 per cent
MgO	1.1 per cent
MgCl	2.5 per cent
Loss in ignition	22.3 per cent
Free water	1.5 per cent

Millet Clay Deposit. The deposit is situated in the west half of Sec. 31, T. 9 N., R. 3 W., S. B. M., 3 miles west of Hicks, a station on the Santa Fe Railroad. Owners, M. J. Millet and J. J. Kennedy, Daggett, California.

The clay is exposed on the surface about one-quarter of a mile south of a *ganister* deposit that is owned by the *Atlas Fire Brick Company* of Los Angeles. The clay bed is from 10 to 20 feet thick and can be traced along its east-west strike for a distance of several thousand feet. The clay is white to buff fire clay. Developments consist of open cuts. Idle.

Bibl: Bull. 99, pp. 195–196.

Standard Sanitary Company's Deposit. The deposit is situated one-half mile south of Hart. Owner, Standard Sanitary Company, Richmond, California.

The clay beds are from 60 to 70 feet in thickness. The clay is a white-burning ball clay.

Development consists of a tunnel 200 feet in length. From this tunnel the clay is mined in chambers, in sections 30 by 30 feet. The clay is hauled by motor truck to Ivanpah, a station on the Union Pacific Railroad, a distance of 15 miles. The production varies from 15 to 20 tons per day and the deposit is worked for three or four months of the year. Four men employed.

Bibl: Bull. 99, pp. 196–198.

Velvet White Filler Deposit. The deposit is situated 5 miles north of Oro Grande and 3½ miles east of Bryman, a station on the Santa Fe Railroad, in the Oro Grande Mountains. Owner, Velvet White Filler Company; A. B. Clark, president, Wayne, Nebraska; R. S. Clark, secretary, 510 West Sixth street, Los Angeles.

Clay occurs in lenses. One lens has an average thickness of 17 feet, maximum of 25 feet. Strike of clay beds is N. 40° W. and occurs between walls of felsitic rock. The deposit consists of seams of white silica, talc and kaolin. The raw clay is stated to contain 25 per cent aluminum.

The plant has a capacity of 8 tons per day. The process of treatment is as follows:

Raw clay to wash box, with agitators, to classifier; then to revolving screen, screened to pass 100-mesh. The product from screen to settling vats; then to driers; from driers to bar mill and after grinding in mill, the material goes to Bates packing machines.

It is utilized for paint filler, and by rubber manufacturers and for sizing paper. Three men are employed.

Bibl: State Mineralogist's Reports XV, pp. 861–862; XVII, p. 338.

Western Talc and Magnesite Company's Clay Deposit. It comprises 16 claims situated in Secs. 11 and 12, T. 9 N., R. 1 W., S. B. M., 5 miles east of Barstow. Owner, Western Talc and Magnesite Company, Los Angeles.

Beds of fire clay occur on these claims and it is suitable for the manufacture of fire brick. Development consists of shafts and open cuts. Idle.

FLUORSPAR

Fluorspar, or calcium fluoride, CaF_2, is one of the most important nonmetallic minerals from an industrial standpoint. Its principal use is as a flux in the manufacture of steel; also used in aluminum smelting and in the manufacture of enamelware, glazed tile and brick, opalescent glass and certain chemicals.

There are several deposits of this important mineral in San Bernardino County but no commercial production has resulted.

Deposits.

Afton Fluorspar Deposit (Massen). It is situated 3 miles southeast of Afton, a station on the Union Pacific Railroad, in the Cave Canyon Mining District. Elevation 2100 feet. Owners, W. H. Cornell and M. B. Randall, Los Angeles.

The fluorspar is a replacement of limestone on contact of andesite, felsite and sedimentary rocks. The deposit consists of a series of parallel veins, which trend east and west, with varying dips. The veins are from a few inches to 4 feet in width. The area containing these veins of fluorspar is well-defined, being about two miles in length and about one mile in width. The color of the spar is green, white and purple. It is said that the grade mined in sample lots carried from 80 to 85 per cent calcium fluoride, CaF_2, with a silica content of 5.40 per cent.

Analysis is as follows:

Calcium oxide	0.47 per cent
Silica	5.40 per cent
Aluminum oxide	2.26 per cent
Iron oxide	0.14 per cent
Calcium fluoride	90.78 per cent
Loss in ignition	0.95 per cent

Idle.

Bibl: State Mineralogist's Report XVII, p. 343.

Baxter Fluorspar Deposit. It comprises a group of 6 claims, situated south of Baxter, a station on the Union Pacific Railroad. Owner, J. Garrity, Baxter, California.

The color of the spar is green and white. It is reported that the fluorspar has a low silica and lime content.

McDermott Fluorspar Deposit. It comprises a group of 9 claims, situated 4 miles east of Nipton, a station on the Union Pacific Railroad. Owner, Mrs. R. H. McDermott, Los Angeles.

The fluorspar occurs in vein from 12 inches to 3 feet in width. Color: White, green and purple. The spar is stated to carry from 50 to 60 per cent calcium fluoride, CaF_2.

Development consists of two shafts 50 and 60 feet deep, respectively, and a tunnel 20 feet in length. Idle.

Philadelphia Fluorspar Deposit. It is situated 25 miles south of Cima, a station on the Union Pacific Railroad, in the Providence range of mountains. Owners, C. Roberts and H. N. Benson, Los Angeles.

The fluorspar occurs in lenses of 6 inches to 2 feet in width. Fluorspar is said to analyze 74 per cent CaF_2 and 3 per cent SiO_2. The deposit is developed by a short tunnel. Idle.

FELDSPAR AND SILICA

Emsco Ganister Deposits. Owner, Emsco Refractories Company; E. M. Smith, president; S. B. Findley, vice-president and general manager; local plant address: 5601 South Boyle avenue, Los Angeles.

This company opened a quarry which is approximately $2\frac{1}{2}$ miles northeast of Wilde siding on the Santa Fe Railroad, about 20 miles northeast of Oro Grande.

It is in a cone-shaped hill, about 150 feet high. The entire upper portion of this hill is composed of quartzite. It is probably 200 feet thick—the strike is N. 35° W. and it dips 45° NE.

Development consists of an open cut and a short tunnel, the portal of which was closed at the time of visit. A bin and two houses were erected on the property.

The above described deposit was abandoned and the company transferred its operations to a similar deposit which is approximately nine miles east and slightly north of Victorville.

Here a quarry face has been developed which is 300 feet long by 20 feet high, in a wide belt of quartzite, the strike of which is east-west, dip 45° N.

This quarry is about one mile from the Southwestern Portland Cement Company's railroad, which connects with the Santa Fe at Victorville.

Material is shipped to Los Angeles for the manufacture of fire brick. There are three men employed loading with a gasoline driven shovel.

Kennedy or Atlas Fire Brick Company ganister deposit is about four miles northwest of Wilde siding on the Santa Fe Railroad. This deposit is similar to the Emsco and is probably a continuation of the same quartzite belt. Owner, Mr. Kennedy of Daggett, California. Idle.

Keystone and Lucky Jim Deposit. This property, consisting of ten claims, is located in Secs. 20 and 29, T. 2 N., R. 3 W., S. B. M., about one mile southwest of Arrowhead Lake, on the southwest slope of the San Bernardino Mountains. Elevation 5500 feet. Owners, C. Lillibridge and E. R. E. Nonhof of Corona, California. Under lease to W. M. Bledsor, on the property.

A series of segregations of feldspar and quartz occur in the granite; strikes vary from N. 10° W. to N. 55° W. All dip about 30° to the west.

Development consists of open cuts and short tunnels. Exposures in these workings show up to 4 feet of mixed quartz, feldspar and mica. In one place on the Lucky Jim No. 1 claim a shallow open cut shows a zone nearly 20 feet wide, with from 1 foot to 3 feet of spar on each side. This cut is too shallow to determine if the feldspar is clean or mixed with silica.

Reported to have shipped 30 tons of feldspar, 11 to 12 tons of silica and one ton of mica.

Lucky Betty Mining Company has 150 mining claims in the southeast foothills of the Clark Mountains, 16 miles southwest of Roach, Nevada. Elevation 4000 feet. Owner, Jos. Irwing, 1639 E. 102d street, Los Angeles; Clyde C. Downing, Reeves Aylmore and W. F. Baldwin.

A series of parallel pegmatitic dikes occur in the granite. Strike north-south, dip 60° W. These dikes are from 8 feet to 20 feet wide and are traceable across the property for a distance of about $1\frac{1}{2}$ miles. Usually they are typical pegmatites, but frequently segregations of mica are found. Present development work consists of open cuts and short tunnels. It is proposed to develop the property by means of crosscut tunnels, the principal one of which has been started at a point some 200 feet west of the test plant.

Material is dumped into a 25-ton bin, thence by belt feeder to No. 1 Irving rock breaker, to bucket elevator, to $\frac{1}{4}$-inch vibrating screen; oversize passes over a steel lip beneath which is a slot through which a current of air is blown. This air current carries the mica over another lip, whence it falls into the No. 1 mica bin. The particles of silica, feldspar and mica which are not carried over by the air current return to the breaker. Screenings from $\frac{1}{4}$-inch screen go to 8-mesh vibrating screen, which has the same arrangement for air classification as the $\frac{1}{4}$-inch screen. This mica product goes to No. 2 bin; also here the silica and spar mixture which is not blown over goes to a finished product bin. The minus 8-mesh goes to 16-mesh vibrating screen where the same operation is repeated. The products are No. 3 mica and No. 2

Barber Bentonite Deposit, 18 miles north of Harvard, San Bernardino County.

silica and spar. The minus 16-mesh goes to waste. Plant has a capacity of 100 tons per 24-hour day.

It is reported that the operation of this plant is satisfactory, its success being attributed to the breaker which separates the mica leaves without breaking them.

H. E. McKnight of Los Angeles has a deposit of *Cornish stone* in Sec. 16, T. 7 N., R. 2 E., S. B. M. It is at Willis Wells on the east slope of the Ord Mountains, 20 miles north of Box S Ranch. Holdings comprise 640 acres.

White Rock feldspar deposit consisting of two claims is 24 miles west of Needles and 6½ miles south of the highway. It is about 10 miles southeast of Goffs. Owner, P. Gerber, 7364 Sunset boulevard, Los Angeles.

It is reported that a 25-foot tunnel has been driven on a mixed quartz and feldspar segregation in the granite. The zone is 15 to 18 feet wide. Idle.

FULLER'S EARTH

Fuller's earth includes many kinds of unctuous clays. It is usually soft, friable, earthy, nonplastic, white and gray to dark green in color. Clays of the bentonite and hallosite group are being utilized by some of the oil refineries in California in lieu of true fuller's earth in the refining of petroleum products. The increasing demand for bentonite, a colloidal clay, has led to opening and development of a number of extensive deposits in San Bernardino County. There is a large increase in both amount and value of the 1929 output of this material over the previous year.

Bibl: State Mineralogist's Report XV, p. 863; Bull. 38, p. 275.

Deposits.

Balch Bentonite Deposit. It comprises a group of 6 claims, situated 10 miles northeast of Balch, a station on the Union Pacific Railroad, in Old Dad Mountains. Owners, F. H. Lietzon and Edward Saxton, of Los Angeles.

The clay beds have a thickness of 10 feet and an approximate width of 700 feet. Developed by a number of shallow open cuts.

Analysis:

Silica (SiO_2)	62.80 per cent
Iron Oxide (Fe_2O_3)	2.07 per cent
Aluminum Oxide (Al_2O_3)	18.45 per cent
Calcium Oxide (CaO)	0.98 per cent
Magnesium Oxide (MgO)	4.71 per cent
Alkalies	3.09 per cent
Total	98.72 per cent

Barber Bentonite Deposit. It comprises 320 acres, situated 18 miles north of Harvard, a station on the Union Pacific Railroad and in the vicinity of Bitter Springs. Owner, A. M. Barber, Los Angeles.

The bed of bentonite that has been exposed by two open cuts has a thickness of over 100 feet and can be traced for over 3000 feet. The

bentonite is white in color and of good quality. This deposit has possibilities of developing into a large producer. Four men employed.

California Talc Company's Bentonite Deposit. It comprises 320 acres, situated 5 miles south of Hector, a station on the Santa Fe Railroad, in the Lava Bed Mining District. Owner, California Talc Company; R. E. Scott, secretary, Los Angeles.

Bedded deposit of bentonite that is covered with an overburden of basalt and rhyolite. The bed has been exposed by open cuts for a length of 500 feet along its strike and about 150 feet in width. The bentonite is white in color and of good quality.

The company plans to ship a large tonnage to its plant which is located in Los Angeles. Six men employed.

Horner Bentonite Deposit, consisting of 60 acres, is 20 miles east of Newberry, 25 miles west of Ludlow and 6 miles southeast of Hector, a station on The Atchison, Topeka and Santa Fe Railroad. Owner, California Talc Company, 837 West Jackson street, Los Angeles.

This deposit is in the Lava Beds District and is partially covered by the basaltic lava.

The bentonite occurs in layers which alternate with thin beds of limestone. The average thickness is probably about 4 feet. It outcrops intermittently over a distance of about 3 miles in the valley. Where there is no lava, the overburden consists of about 4 feet of ordinary aluminum clays. Colors are white to brown, the white being somewhat in excess.

The deposit has been opened by an open pit about 100 feet long by 25 feet wide and a maximum depth of 10 feet. Twelve cars have been shipped from this excavation. It is used in making a jel for oil-well mud.

Seven men are employed and their work is directed by V. M. Arciniego, superintendent.

Massen and Capek Bentonite Deposit. It comprises 60 acres, situated in T. 11 N., R. 5 E., S. B. M., 2½ miles north of Dunn, a station on the Union Pacific Railroad. Owner, J. H. Massen and J. W. Capek, Los Angeles.

A number of shallow open cuts expose a bed of bentonite which is said to be of good quality and there appears to be a possibility of developing a large tonnage. The bentonite is associated with red clay and iron oxide. Idle.

Potter Bentonite Deposit. It comprises 480 acres, situated in T. 9. N., R. 1 W., S. B. M., 5 miles southeast of Barstow. Owner, Elmer Potter, Los Angeles.

The bed of bentonite is from 15 to 20 feet thick and has been exposed for a distance of 500 feet along its strike. The bentonite is white to gray in color and reported to be of good quality. Idle.

GEMS

The gem stones that have been found in the desert sections of San Bernardino County are as follows: Agate, garnets, quartz crystals, lapis lazuli, sapphires and turquoise.

There has been no recorded production of gem materials from the county in recent years. The turquoise deposits which are located in the Solo Mining District, 30 miles northwest of Cima, a station on the Union Pacific Railroad, were last worked in 1903.

Bibl: Bull. 37, pp. 76–167; State Mineralogist's Report XV, pp. 863–868; U. S. Geol. Survey Mineral Resources 1898, pp. 582–584; Mineral Resources 1911, Part II, pp. 1059–1060.

GARNET

Allison Deposit is 6 miles northeast of Amboy in the Bristol Mountains. It is on the ground known as the Snowcap Limestone Deposit. Owner, Robert Allison, Nadeau Hotel, Los Angeles.

The garnet, which is finely crystalline, occurs in the limestone, or more probably at its contact with an igneous dike, which, however, is not exposed on the surface. The strike is east-west and it is apparently some 20 feet wide. It may be traced over a spur for a distance of several hundred feet. The individual crystals are comparatively small; the color varies from green, through red to almost black. It is suitable for use as an abrasive.

Lena Louise Garnet Group of 5 claims is in the Marble Mountains, 5 miles north of Cadiz, a station on the Santa Fe Railroad. Owner, J. A. Chambless, Amboy, California. It is under lease to H. E. Brown, 3202 Ellis Street, Berkeley, California.

It is reported that there are two principal contact zones into which the garnet minerals are segregated. Limestone and granite form the contacts. The strike is northwest-southeast. The zones are said to be approximately 100 feet wide and the garnet 'veins' are accompanied on each side by zones filled with iron and epidote.

The lessee is building a road to the deposit preparatory to shipping the material for use as an abrasive.

GYPSUM

Deposits of gypsum occur in the desert region of San Bernardino County, but there has been no production in recent years. Gypsum occurs loosely cemented with sand in coarse crystals in Bristol Lake near Amboy. A similar deposit occurs at Danby Dry Lake. Gypsum also occurs in thin-bedded deposits associated with the beds of rock salt in the Avawatz Mountains and to a lesser extent, in the borax beds of the Calico District.

Bibl: State Mineralogist's Reports XV, pp. 868–870; XVII, pp. 351–352; XVIII, p. 232; Bull. 38, 67, 91; U. S. Geol. Survey Bull. 223, 413, 430, 697; U. S. Bur. of Standards, Circular No. 281.

Couchman Gypsum Deposit. It comprises 160 acres, situated at Coyote Holes, 12 miles NE. of Valjean, a station on Tonapah and Tidewater Railroad. Owner, J. Couchman, Los Angeles, California. Analysis show 94 per cent gypsum. Reported that the gypsum beds are extensive. Undeveloped.

LIMESTONE (CEMENT, MARBLE AND DOLOMITE)

Arlington Mining Corporation has deposits of limestone in Blackhawk Canyon, which is on the northeast slope of the San Bernardino Mountains, largely in T. 3 N., R. 1 E., S. B. M., some 25 miles southeast of Victorville. Elevations range from 4200 to 6700 feet. Owner, Arlington Mining Corporation; Algernon Del Mar, president; Roy K. Voorhies, secretary. Offices: 740 South Broadway, Los Angeles.

In a bulletin written by A. O. Woodford and T. F. Harriss, issued by the Department of Geological Sciences of the University of California, Vol. 17, No. 8, the geology of this region is discussed in detail. Sections shown in this paper indicate thicknesses of limestone up to some 700 feet.

Quoting from this publication, under description of the Furnace Limestone: "It is crystalline, the mineral individuals averaging about one millimeter in diameter. Sometimes banding is pronounced owing to variations in color or in grain (even up to centimeter size) or both. The color bands are a few millimeters or centimeters wide and usually caused by vague changes in shade from light to dark gray. Some of the limestone is dazzlingly white, and much of lower portion as here exposed is stained red.

"Some parts of the limestone are composed of practically pure calcite, containing little or no magnesia. Sometimes dolomite grains are common * * *."

Analyses given indicate an average composition of approximately 98 per cent calcium carbonate, and about 1.1 per cent magnesium carbonate.

There are numerous deposits of limestone and marble in San Bernardino County, which because they are idle are not here mentioned. See Bulletin No. 38, pp. 102–106 for additional descriptions.

Baxter and Ballardie Quarries. This property is in Sec. 12, T. 11 N., R. 6 E., S. B. M. It is near Baxter, a station on the Union Pacific Railroad. (See also Pacific Marble Quarries Company.) Idle for the past two years. For description see

Bibl: State Mineralogist's Report XV, pp. 872–876.

Big Pine Deposit, consisting of three placer claims, 480 acres, is in Secs. 1 and 6, T. 3 N., R. 8 W., and Sec. 36, T. 4 N., R. 8 W., S. B. M. It is on the line between Los Angeles and San Bernardino counties, just above and east of Los Angeles County Recreation Camp on the north slope of the San Bernardino Mountains, just north of Swartout Canyon. Elevation 7500 feet. Owners, Big Pine Mining Company; R. E. Shonerd, president, 10909 Kenwood street, Inglewood, California; B. D. Elder, secretary, 3106 Berkeley avenue, Los Angeles.

On this property a belt of limestone from 200 feet to probably 400 feet thick is traceable for more than one mile. The exposures are best seen in the canyons, the outcrop on the tops of the ridges being largely covered by detritus. The strike is east-west, with 45° dip to the south. It is a white crystalline limestone, analyses of which show it to contain from 85 per cent to 95 per cent calcium carbonate.

Only development consists of shallow opencuts scattered over the property.

California Portland Cement Company's plant and quarry is in Secs. 19 and 30, T. 1 S., R. 4 W., S. B. M., about one mile west of Colton. Owner, California Portland Cement Company, Pacific Mutual Bldg., Los Angeles, California; Dan Murphy, president; E. E. Duque, vice president and general manager.

The plant is at the south end of Slover Mountain. This mountain is composed of crystalline limestone, all of which is suitable for the manufacture of cement. It is approximately one mile long, a half mile wide and 500 feet high. The present quarry face is 3500 feet long and has a maximum height of 400 feet.

The material is loaded into cars by steam shovels and hauled to the crushing department by electric storage-battery locomotives.

Cars are dumped by electrical power into 84 by 66 inch jaw crusher, thence to No. 9 gyratory, elevated to No. 18 gyratory; elevator to trommels. The minus $\frac{3}{4}$-inch goes to storage bins, oversize by conveyor to hammer mill which crushes to $\frac{3}{4}$-inch. This crushed material contains the approximate proportions of clay and shale.

From the storage bins it goes through driers to twelve 250-ton proportioning bins, where it is held until analyses of samples show that the proper mixture has been attained. From these bins it goes to the raw-grinding division, consisting of compartment ball mills and Fuller Lehigh mills, equipped with air separators, grinding to 88 per cent minus 200 mesh, thence to storage in silos. From the silos material is delivered to kilns by Fuller-Kinyon pumps. From the kilns to clinker storage; reclaimed by traveling crane, and sent to finished grinding, consisting of tube mills, thence to finished storage.

The packing plant consists of sack cleaning and repairing departments and Bates packers.

Plant is reported to have a capacity of 12,000 barrels daily.

Power is obtained from the Southern Sierras Power Company.

Bibl: State Mineralogist's Reports XV, pp. 857-858; XVII, pp. 335-336.

Chalmers Dolomite Deposit. This property consists of 640 acres, located $2\frac{1}{2}$ miles southwest of Amboy, a station on The Atchison, Topeka and Santa Fe Railroad. Owner, J. K. Chalmers, 632 H. W. Hellman Building, Los Angeles, California.

The deposit forms low hills, which rise from 50 to 100 feet above the floor of the valley. Analyses of the dolomite show that it is composed of 50% $MgCO_3$ and 50% $CaCO_3$.

The freight rate to Los Angeles is $2 per ton. Idle except for assessment work.

Cima Limestone Deposit is in Secs. 12, 13 and 24, T. 15 N., R. 13 E., and Sec. 7, T. 15 N., R. 14 E., S. B. M., about 10 miles northerly from Cima, a station on the Union Pacific Railroad. It embraces 10 placer claims, 1380 acres. Elevation ranges from 4900 to 5900 feet. Owners, H. O. Hinshaw, Riverside County Chamber of Commerce, and R. F. Slaughter, 579 Magnolia avenue, Riverside, California.

The deposit constitutes the main portion of a westerly spur of the Ivanpah Mountains. The high points of this spur rise from 400 to 700 feet above the floor of the valley, while the intervening saddles are from 100 to 200 feet lower.

The individual limestone strata vary in thickness from 10 to 300 feet. The texture varies from very fine grained to coarsely crystalline. The colors are white, light gray and nearly black. Near the summits of the peaks there are some thin strata of brown, siliceous limestone. The dips vary from 20° to 80° N. On the east, the base of the limestone is in contact with a granitic mass, which apparently caused the uplifting.

Analyses of four samples taken from the deposit are reported to average 97.5% calcium carbonate and 0.40% magnesium oxide.

Idle except for assessment work.

Golden State Portland Cement Company's plant at Oro Grande has been taken over by the *Riverside Portland Cement Company,* 621 South Hope street, Los Angeles, California; John Treanor, president.

This plant has been idle for the past two years.

Since the last report some changes have been made in this plant, including the construction of silos for cement storage.

For description see

Bibl: State Mineralogist's Reports XV, pp. 858-859; XVII, p. 336.

Hinkley Dolomite Deposit, comprising 160 acres, is in Secs. 11 and 12, T. 9 N., R. 4 W., S. B. M., four miles southwest of Hinkley, a station on The Atchison, Topeka and Santa Fe Railroad. Owner, R. J. Tones, 906 Colton avenue, Colton, California.

It has been estimated that this deposit contains 25,000,000 tons of dolomite, the analysis of which shows it to be composed of 30% calcium carbonate and 40% magnesium carbonate.

Jack Frost Deposit, consisting of 160 acres, is in the Bristol Mountains 6½ miles northeast of Amboy, a station on The Atchison, Topeka and Santa Fe Railroad. Elevation ranges from 1400 to 1800 feet. Owners, D. N. Smith and associates, Los Angeles, California.

This deposit of crystalline limestone is approximately 3000 feet long, 1200 feet wide and 400 feet thick. The strike is northwest-southeast and the dip 30° to 40° NE.

It has been intruded by a series of dioritic and andesitic dikes, strike N. 30 W., dip 60° to 70° NE.; also deposits of epidote occur at the contact of the limestone with granite near the northeast corner of the deposit.

Idle, except for assessment work.

Lawton Deposits. John P. Lawton of Sierra Madre, California, has deposits of limestone and dolomite in sections north of Keenbrook, a station on the Santa Fe Railroad. Holdings comprise 800 acres.

Lucky Strike Deposit, consisting of 160 acres, is in T. 2 N., R. 4 W., S. B. M., on the southwest slope of the San Bernardino Mountains, about 12 miles north of the city of San Bernardino.

The Arrowhead Lake highway passes through this deposit. Elevation, approximately 4500 feet. Owners, C. Lillibridge and E. R. E. Nonhoff, Corona, California, under lease to Harry D. Stanley, 916 South Lake street, Los Angeles, California.

The new highway to Arrowhead and Big Bear Lakes is cut through the limestone on this property and is the only development work which

was seen. It is white to gray in color and apparently is high grade crystalline limestone. The deposit has an apparent thickness of from 150 feet to 200 feet and has been exposed in the highway cut for a distance of about 1000 feet. At the west end of the exposure the dip is about 20° to the east, but a very distinct north-south fault crosses it near the upper or east end. Beyond this fault, which is indicated by a thoroughly crushed zone more than 100 feet in width, the dip is approximately 15° to the west. The mountain side is very steep and quarrying without interfering with the highway would be difficult.

A. B. McAntire, 7721 South Main street, Los Angeles, and Elmo Proctor, Yermo, California, own a deposit of marble in the Mojave Sink country. It is 4½ miles east of Soda, a station on the Tonopah and Tidewater Railroad, and 10 miles south of Baker. Holdings comprise 4 claims.

The deposit forms a hill which rises approximately 400 feet above the floor of the valley.

It is reported that the marble, which occurs in beautifully variegated colors, may be quarried in blocks of sufficient size to be used in the building trades.

To date only assessment work is being done.

Mojave Marl Company has a mill at Wilde Siding on the Santa Fe Railroad, about 16 miles east of Oro Grande. Their deposit is about 2 miles west of the mill and one mile north of the railroad. Owner, Mojave Marl Company, 374 Court street, San Bernardino, California; L. Johnson, president, 472 Fourteenth street, San Bernardino. The plant consists of Williams mill, to 14-inch conveyor belt to bins, thence to 20-inch belt conveyor to elevator and railroad cars. Capacity of plant is 15 tons per hour. Now shipping 35 to 50 tons per day into the orange belt for fertilizer.

O'Connell Deposit consisting of six claims, each 160 acres, is 3 miles southeast of Ivanpah, a station on the Union Pacific Railroad. Owner, Tom O'Connell, San Bernardino, California.

This belt of limestone is here 300 feet wide. Its strike is northeast-southwest and it dips to the north. It is reported to average 99% calcium carbonate.

Idle, except for assessment work.

Pacific Marble Quarries Company (see also Baxter & Ballardie Quarries), Citizens' National Bank Building, Los Angeles, California. R. B. Knox, president; J. M. Finlayson, secretary.

This company operated the Baxter and Ballardie Quarries, 1923-1926.

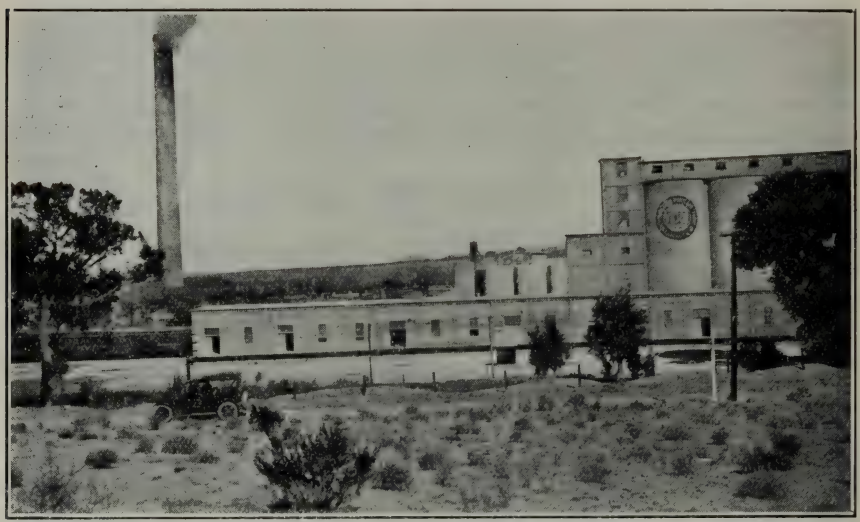
Bibl: State Mineralogist's Report XV, pp. 872–876.

Parker Marl Deposit. W. Floyd Parker, 1320 Angeleno street, Los Angeles, California, has a marl deposit, consisting of 8 claims, 1780 acres. It is 7 miles east of Barstow. Idle.

Schiedel Deposit is in Secs. 5, 11 and 14, T. 12 and 13 N., R. 14 and 15 E., S. B. M., about 5 miles from Elora, a station on the Southern Pacific Railroad. Owners, John Schiedel, 639 St. Paul avenue, Los Angeles, and associates.

It is estimated that there is 500,000 tons of pure crystalline limestone on these two claims.

Silver Dome Deposit is in Sec. 32, T. 12 N., R. 42 E., M. D. M., 20 miles southeast of Randsburg. It consists of 160 acres, held in conjunction with the lode claims, comprising the gold mine of the same name. It is easily accessible by level roads from Fremont Siding on the Kramer-Johannesburg Branch of the Santa Fe Railroad. Owner,



Southwestern Portland Cement Company's plant, Victorville, California.

Silver Dome Mining Company, Phoenix, Arizona; Capt. A. Rolling, president; Fred Knappen, secretary.

The deposit which forms a long, low, gently sloping hill, is estimated to contain fifteen million tons of clear white crystalline limestone, which is composed of 98% calcium carbonate.

Development consists of small open cuts and short tunnels.

Snowcap Limestone Deposit, consisting of 160 acres, is about 6 miles northeast of Amboy, a station on the Santa Fe Railroad. It is on the southeast slope of the Bristol Mountains. Owner, Robert Allison, Nadeau Hotel, Los Angeles, California.

This deposit is easily accessible from Amboy over a good road, no grades.

The deposit is approximately 700 feet thick by 1500 feet long. The main portion of it forms a cone-shaped peak some 350 feet high. It is reported that the entire deposit consists of a white, crystalline limestone which is approximately 98 per cent calcium carbonate.

Snow White Marble Company's deposit is in the New York Mountains, 4 miles southwest of the town of Barnwell. It adjoins the Sagamore Mine.

The property, consisting of 6 claims, 120 acres, is owned by J. L. Parsons, 1987 Linda Vista, Pasadena, and J. I. Taft, 1968 West avenue, Linda Vista, California, and associates.

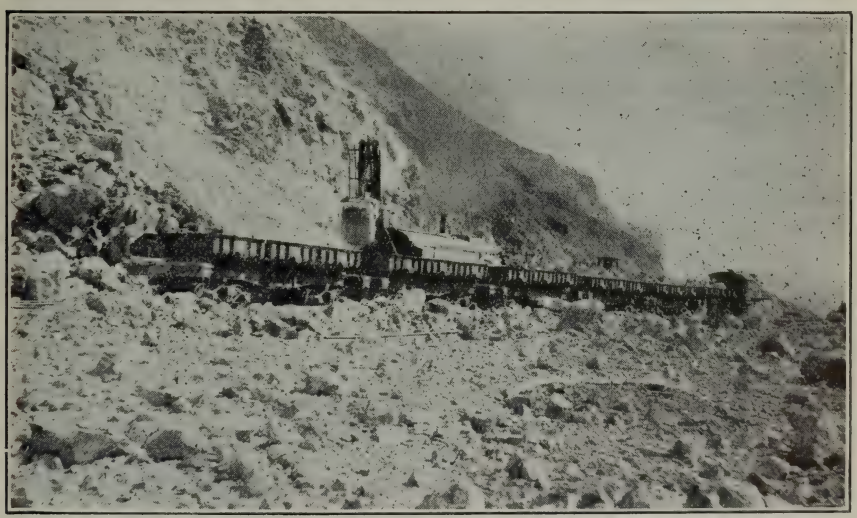
Southwestern Portland Cement Company, H. W. Hellman Building, Los Angeles, California. F. H. Powell, president; M. A. Koffman, secretary.

This company supplies its cement plant at Victorville with limestone from its quarries, which are some seven miles distant in a northeasterly direction.

Five quarries have been developed in a limestone belt, the strike of which is east-west, dip 45° N. To the south is a wide belt of quartzite, through about 200 feet of shale, against which is a monzonite of undetermined extent. The actual thickness of the limestone is nowhere, as yet, exposed, although some quarry faces are nearly 200 feet high. The limestone is crystalline, the color being both blue and white.

The five quarries are in two hills, separated by a shallow canyon. Quarries Nos. 1, 3 and 5 in the most northerly hill, have an aggregate quarry face length of 3200 feet by an average height of approximately 75 feet. Quarry No. 4, to the south, has an 1800-foot face, which is in one place 180 feet high.

The rock is loaded into 30-ton, standard gauge side-dump railroad cars by one Bucyrus electric shovel, 3-cubic-yard dipper, caterpillar type and one Bucyrus steam shovel, 1¾-cubic-yard dipper, railroad type; also one Marion electric shovel, 2½-cubic-yard dipper, caterpillar type. The company owns and operates the seven miles of railroad over which these cars are pulled to their plant.



Limestone Quarry. Southwestern Portland Cement Company, Victorville, California.

Other equipment at the quarry consists of 2 steel and 1 wooden Armstrong drill rigs.

The plant has been described in our former reports, since which time, however, its capacity has been increased to 6000 barrels daily. Two kilns have been added; one 200 feet long by 9 feet in diameter; the other is 200 feet long by 9 feet in diameter at the feed end and 13 feet 6 inches in diameter at the burning end.

The silo capacity has been increased to 140,000 barrels.
A total of 270 men are employed.

Bibl: State Mineralogist's Reports XV, pp. 859–860; XVII, p. 337.

Standard Limestone Deposit is 2 miles northeast of Ivanpah, a station on the Union Pacific Railroad. It comprises six 160-acre claims. Elevation 4000 feet. Owner, Standard Lime Chemical Company, L. Brandenberg, president, Los Angeles, California.

This deposit consists of a belt of white and gray crystalline limestone which is reported to consist of 99 per cent calcium carbonate. It is approximately one mile wide by two miles long, strike N. 30° W.

Development consists of a 30-foot shaft and exposures in cuts of the old Ivanpah branch railroad.

Three Colored Marble Quarry is in the unsurveyed portion of T. 7 N., R. 2 W., S. B. M., 22 miles south of Barstow.

For description of this deposit see

Bibl: State Mineralogist's Report XV, pp. 881–883.

Verde Antique Marble Quarry, formerly known as the Gem Quarry or the Kimble Mine, is in Sec. 28, T. 7 N., R. 2 W., S. B. M., about 2 miles southwest of the Three Colored Marble Quarry.

Bibl: State Mineralogist's Report XV, p. 883; Bulletin 38, pp. 147–148.

MAGNESITE

Afton Magnesite Deposit. It comprises 3 claims, situated 1½ miles east of Afton, a station on the Union Pacific Railroad. The deposit is located on a steep hillside on the east side of Cave Canyon.

The deposit of magnesite is 10 to 20 feet thick, strikes east and west and dips north. The magnesite underlies a soft, red-colored, decomposed conglomerate. The footwall of the magnesite vein is made up of sandstone and dark, bluish, gray shales. Its color varies from pinkish to dead white. Occasional seams of silica are imbedded in the magnesite.

Analysis of magnesite (Smith-Emery and Company).

Silica (SiO_2)	10.10 per cent
Aluminium (Al_2O_3)	1.73 per cent
Iron (Fe_2O_3)	1.41 per cent
Lime (CaO)	3.10 per cent
Magnesium oxide (MgO)	38.19 per cent
Carbon dioxide (CO_2)	40.65 per cent

Bibl: State Mineralogist's Report XVII, pp. 353–354.

New Trail Magnesite Deposit. This deposit occurs on the claims of the New Trail Mining Company, situated 10 miles northwest of Cima, a station on the Union Pacific Railroad, on the east slope of the Ivanpah range of mountains. Owner, New Trail Mining Company; J. F. Kent, president, Riverside, California.

The magnesite occurs along the bedding planes of dolomitic limestone. The vein of magnesite is 2 to 4 feet thick, strike NE. and SW., dip 45° SW. It has been developed by a number of shafts to a depth

of 80 feet, for a distance of 500 feet along its strike. The magnesite is dead white in color but probably carries high lime content. Idle.

MICA

Practically all marketable mica is the muscovite or phlogopite varieties. There are three main commercial classes: Sheet mica, including punch, splittings and scrap.

Deposits of muscovite associated with feldspar and silica, occur on the east slope of Clark Mountain, at Little Betty Mine. For a description of the deposit, the reader is referred to the Little Betty Mine, described under feldspar and silica.

There is also a deposit of mica situated on the east slope of the Ivanpah range of mountains. This deposit occurs on the southern end of the claims owned by the New Trail Mining Company, of Riverside, California. The mica occurs in quartz-diorite along north and south and northeast and southwest fractures. A number of shallow shafts have been sunk on the deposit, exposing 6 to 8 feet of greenish to black-colored mica. It occurs in plates up to 2 inches but breaks up readily to finer material on being exposed to the air. The deposit has potential possibilities and a large tonnage can be developed.

MINERAL WATER

There are a great many mineral springs in San Bernardino County and these are described in detail in U. S. Geol. Survey Water Supply Paper 338, by Gerald A. Waring.

The principal commercial output of mineral water in the county is from Arrowhead Hot Springs, owned by the Arrowhead Hot Springs Company, offices and bottling plant located at Washington street and Compton avenue, Los Angeles.

Bibl: State Mineralogist's Report XV, pp. 883–890; U. S. Geol. Survey Water Supply Paper 338, pp. 32–36.

SALINES

Under this heading are included borax, nitrates, common salt, soda, potash and other alkaline salts. The main resources of the salines are the dry lake beds of the desert region of San Bernardino County.

The principal commercial production of the salines is made up of borax, salt, soda, potash, magnesium chloride, magnesium sulphate and calcium chloride.

Borax, soda and potash are recovered from the brines of Searles Lake, which is located in the northwest corner of the county. San Bernardino County is the chief source of potash in the United States and the source of supply is in the saline brines of Searles Lake.

Nitrates of sodium, potassium and calcium have been found in various places in the desert regions of the county, but no deposit of commercial value has been developed as yet.

The principal deposits of salt occur in the dry lake beds of Bristol Lake, near Amboy, Danby Dry Lake and Cadiz Dry Lake, near Milligan. The principal production of sodium salts in the county is recovered from the brines of Searles Lake, in the form of soda ash, bicarbonate of soda, and trona (sesqui-carbonate), a double salt of

Na_2CO_3 and $NaHCO_3$. The production of calcium chloride came from two plants, being obtained as a by-product in the refining of salt from the deposits of Bristol Lake. The first commercial production reported was in 1921. The production from 1921 to 1929, amounted to 47,070 tons valued at $887,184.

BORAX

The first production of borax in the county was from the dry lake (playa) deposits, and began in 1873; but it was not until 1887 that the borax industry was revolutionized by the discovery of the colemanite beds in the Calico Mountains.

The production of borax from this district amounts to more than $10,000,000. About 1892 extensive deposits of colemanite were found in Inyo county, which caused the suspension of operations in the Calico district, and only a small amount of selected ore has been shipped from these deposits in recent years. At present writing the only production of borax is crystallized borax prepared by evaporation of the brines of Searles Lake. The present production amounts to about one-third of the borax produced in the United States.

MAGNESIUM SALTS

American Magnesium Company, T. W. Wright, president, Los Angeles, California. This company owns 1000 acres of placer ground, carrying soluble magnesium sulphates, located in T. 25 S., R. 46 E., S. B. M., 30 miles east of Magnesium, a siding on the Trona Railroad. The plant is located on the southwest shore of Searles Lake, 6 miles south of Trona. A monorail crosses Searles Lake from the plant to the deposit, a distance of 30 miles. Product produced was magnesium carbonate and magnesium sulphate (Epsom salts). After short period of operation the company closed down. Idle.

NITER

The existence of niter in the low, rolling hills along the Amargosa River has been known since the early eighties. The niter beds are situated in the northern part of San Bernardino County, extending across the boundary line into the southeastern part of Inyo County. The formation of the niter-bearing hills occurred in the early Tertiary period, and are the result of sedimentary marine deposits slowly accumulating in thin layers. These beds have been worn by erosive agents into soft rounded hills and knobs. The hills are covered with a crust; this crust, varying from a few inches to over a foot in thickness, is termed 'Caliche.' The 'Caliche' contains niter, and also the clay beds underlying the 'Caliche' contain niter. It is reported that the 'Caliche' contains from 5 per cent to 10 per cent niter.

Bibl: State Mineralogist's Report No. XV, pp. 890–891; Bulletin 24, pp. 174–178.

POTASH

American Potash and Chemical Company. H. S. Enslow, president; F. C. Baker, vice president; F. C. Baker, secretary and treasurer; offices, New York City. Plant executives: Frederick Neweg, general

manager; W. E. Burke, assistant manager; O. M. Simpson, assistant manager; offices, Trona, California.

The plant is situated on the northwest shore of Searles Lake. Elevation, 1600 feet. Holdings comprise about 3320 acres. Searles Lake is a broad circular valley or depression from 8 to 10 miles from east to west and from 20 to 25 miles from north to south. This basin lies between the Argus range on the west and the Slate range on the east.

The saline deposits of Searles Lake comprise several distinct areas. First: The central area of firm crusted salt, consisting of the main salt deposit, or crystal area, which is 13 square miles in extent. Second: The playa zone, including the central salt area and a broad surrounding margin of salt incrusted mud and sand, composed of mud and mixed alluvial material. The area of the playa zone is about 60 square miles. The average depth of the salt in the main part of the deposit is 70 feet.

The whole body of salt in this shallow basin of crystallized salts and brine is composed of five definite materials.

1. Halite—($NaCl$).
2. Trona—($Na_2CO_3.NaHCO_3.2H_2O$).
3. Hanksite—($9Na_2SO_4.2Na_2CO_3KCl$).
4. Borax—($Na_2B_4O_7.10H_2O$).
5. Glaserite—($3K_2SO_4.Na_2SO_4$).
6. Burkeite—($2Na_2SO_4.Na_2CO_3$).

Composition of Searles Lake Brines:

Sodium Chloride ($NaCl$)	16.36	per cent
Sodium Carbonate (Na_2CO_3)	4.86	per cent
Sodium Sulphate (Na_2SO_4)	6.85	per cent
Potassium Chloride (KCl)	4.74	per cent
Sodium Borate ($Na_2B_4O_7$)	1.50	per cent
Total solids	34.38	per cent

The base of the deposit consists primarily of sodium carbonate and sodium bicarbonate. There is an increase in the upper parts of the deposit of sodium sulphate and a concentration of sodium chloride at the top of deposit.

Plant. Commercial production of potash by the plant of the American Potash and Chemical Company, started in 1916, and was under continuous operation from 1916 to 1921, when operations were suspended until the early part of 1922, for experimental purposes, and also to increase the capacity of the plant. Since March, 1922, the plant has been operating continuously. The production of borax was started in 1924, which was increased to 125 tons in 1927. The production for the year 1928 amounted to 138,291 tons of potash and borax salts, the net profit for the year being $1,556,541. The net income reported for the year 1929 was $1,348,428, with net sales from potash and borax salts amounting to $4,279,600. The present production of the plant amounts to 140 tons of borax, having a grade of 99.95 per cent borax, and 256 tons of potash carrying 95 per cent KCl, per day.

Power Plant. It comprises a battery of 14 Babcock-Wilcox boilers, each rating 500 h.p., the total horsepower generated being from 7000

to 10,000 h.p. with three chimney flues, 150 feet in height by 9 feet in diameter. The power plant uses 55,000 gallons of crude fuel-oil per day. The cooling towers adjoining the plant have a capacity of 20,000 gallons of water per minute. The steam from the boiler plant goes directly to two General Electric Company steam-turbine generators which furnish power for the operating plant, also light for plant and buildings on the company's property. The exhaust steam from the turbines goes to triple-effect evaporators. The compressor plant consists of six compressors, and three refrigerating engines for use in the process of refrigeration and crystallization of borax. The brine treated carries from 4.75 per cent to 5 per cent KCl and has a temperature of 72° F.

Method of Treatment of Brines. Ten wells have been sunk in the center of Crystal Lake area, and brine is pumped by centrifugal pumps through an insulated pipe line 10 inches in diameter, a distance of about 3 miles to large steel storage tanks having a capacity of 2,000,000 gallons of brine. The brine from storage tanks is pumped to two units of triple-effect evaporators, each unit consisting of three pans; each pan is comprised of a heater, flashing chamber and vapor lines. The pans are 22 feet inside diameter by 85 feet high.

Process. The process used is evaporation and crystallization and is described in detail by John E. Teeple, Ph. D.[1]

The storage buildings have a capacity of 15,000 tons of borax and 12,000 tons of potash. Railroad cars run direct into storage buildings, where the crude and sacked products are loaded into cars for shipment.

The company also manufactures boric acid; the product produced amounts to 10 tons per day of refined boric acid, for use in the technical and chemical trade.

A total of 525 men is employed.

Bibl: State Mineralogist's Report XVII, pp. 357–358. Chamber of Mines & Oil Bull. July, 1919, 'Potash of Searles Lake' by Alfred De Ropp, Jr. American Chemical Society, Monograph Series, No. 49.

Borosolvay Plant. It is situated on the west shore of Searles Lake, 2½ miles south of Trona, at Borosolvay. Holdings comprise 1000 acres of patented ground. Owner, *Pacific Coast Borax Company.*

This plant was operated by the *Solvay Process Company* of New York from September, 1916, until 1920, when the operations were suspended. It is reported that the plant during this period of operation produced about 200 tons of potash per month. Idle.

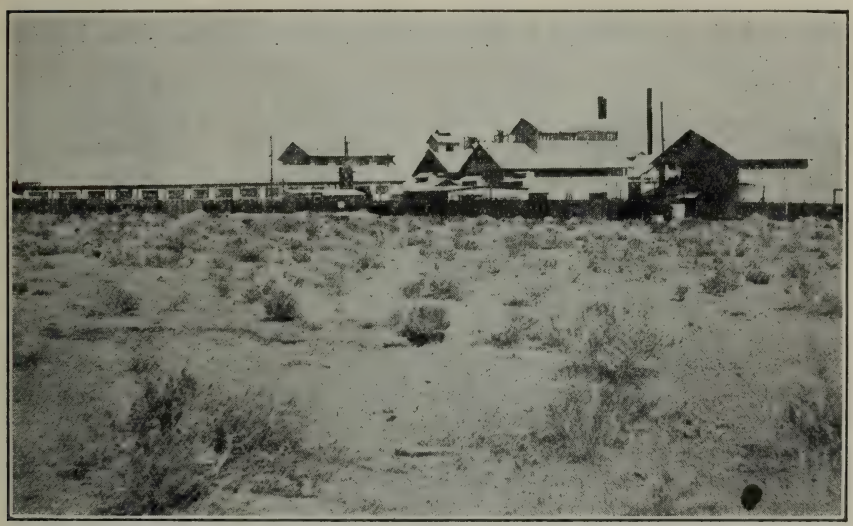
Burnam Chemical Company. C. B. Burnam, president; E. D. Whitney, secretary. Offices: 433 California street, San Francisco, California.

The experimental plant of this company is located 4 miles south of Trona and 2 miles east of the west shore of the lake in the Crystal salt area. The camp and warehouse is located on the west shore of

[1] "The Industrial Development of Searles Lake Brines" in American Chemical Society Monograph Series, No. 49, published by Chemical Catalog Co., Inc., New York City.

the lake. The plant has a capacity of 50 tons per day. The process used is solar evaporation. The products recovered from the brines are borax, potash and glaserite ($3K_2SO_4.Na_2SO_4$). The solar evaporation ponds cover 160 acres, which is divided up into 20-acre ponds.

The raw brine from these evaporation ponds is pumped to concentration ponds. The concentrated brine is then pumped to spray pond, equipped with Dorr thickener mechanism. The borax recovered in the plant is reported 99.5% pure. The borax was hauled by truck from this plant to warehouse on the west shore of the lake. The crude borax crystals were put through Raymond Pulverizer mill, dried and



Solvay Process Company's plant. Borosolvay, Searles Lake, California.

sacked for shipment. When the plant was under operation the output is reported to have been 15 tons per day of refined borax. Ten men are employed on construction work.

SALT

Avawatz Salt and Gypsum Company, offices: Garland Building, Los Angeles, own large deposits of salt situated in the Avawatz Range of mountains about 12 miles west of Riggs, a station on the Tonopah and Tidewater Railroad. The salt is found in the deposits in enormous quantities. These salt deposits are known as Jumbo salt area, Salt Basin area and Valley salt area.

Rock salt of great purity is found in these areas; individual beds are over 50 feet thick, interstratified with insoluble clay, sand and anhydrite; total thickness and proportion of salt to insoluble material unknown. The salt is usually massive and does not show crystalline structure. The color is usually reddish or brown, though there are occasional seams of clear white salt. Chemical analyses show purity

as high as 98%. There are places in the above-mentioned areas where the salt stands over 100 feet thick, above the canyon bottoms.

Approximate estimates of the tonnage of salt contained in the Avawatz Mountains:

Jumbo salt area	9,000,000 tons
Salt Basin area	8,000,000 tons
Valley salt area	5,000,000 tons

Deposits are undeveloped principally due to their inacessibility. Idle.

Bibl: State Mineralogist's Reports XVII, p. 357; XVIII, p. 116; Bull. 24, pp. 126-128; U. S. Geol. Survey Bull. 540, pp. 526-530.

Cadiz Dry Lake Salt Deposits. These salt deposits are located in T. 2 and 3 N., R. 15 E., S. B. M., 12 miles west of Milligan, a station on the Santa Fe Railroad. The surface of Cadiz Dry Lake is made up of sand and clay mixed with gypsum. Test holes sunk in the lake bed encountered crystalline gypsum and salt with brine. The salt beds are from 5 to 7 feet thick. The gypsum and salt beds are interstratified with brown sand or sandy clay. The brines contain a considerable percentage of calcium chloride.

Bibl: U. S. Geol. Survey Bull. 578, p. 695; 669; Mineral Resources 1917 and 1920.

California Rock Salt Company. W. F. Bledenbach, president and manager; offices: 2465 Hunter street, Los Angeles. The plant is situated 6 miles east of Amboy at Saltus, a station on the Santa Fe Railroad. The salt and bittern pits are located 5 miles south of the plant on Bristol Dry Lake. The deposit of salt occurs on the south side of the lake. The salt beds are 8 feet thick, being overlain by 3 to 4 feet of sand and clay mixed with gypsum. The overburden is first removed by scrapers and gasoline-driven shovels. The material from salt pits is hauled by 20-h.p. gasoline-driven Plymouth locomotive, which hauls a train of 8 Western side-dump cars to the mill, a distance of 4 miles. The salt treated in the plant is crushed, washed and screened, the size of product being $\frac{1}{8}$-inch, $\frac{1}{4}$-inch and $\frac{1}{2}$-inch. The plant has a daily capacity of 100 tons of finished product. Products produced are salt and calcium chloride. Twelve men employed.

Bibl: State Mineralogist's Report XVII, p. 357; U. S. Geol. Survey Bull. 669.

Danby Dry Lake Salt Deposit. It comprises 660 acres of patented land located on Danby Dry Lake near Ward, a station on The Atchison, Topeka and Santa Fe Railroad on Parker cut-off. Owners, R. B. Evans of Pasadena and Russ Avery of Los Angeles, California.

A bed of salt from 8 to 15 feet in thickness occurs below the lake surface, being overlain with 3 to 5 feet of sand and clay mixed with gypsum.

The salt is quite pure, as analysis shows 98% sodium chloride. The estimated tonnage in this deposit is stated to be 25,000,000 tons. Two men employed.

Bibl: State Mineralogist's Report XVII, p. 357.

Saline Products Company, Inc., X. H. Hollar, vice president and manager; offices: 2000 Santa Fe avenue, Los Angeles, California.

The plant of this company is located at Funston, a siding on the Santa Fe Railroad, 5 miles south of Amboy.

The salt and bittern pits are located on the southern side of Bristol Lake, about 5 miles south of the plant.

The deposit of rock salt is 3 to 6 feet in thickness, being overlain with 4 feet of sand and clay mixed with gypsum.

A series of vats have been excavated by gasoline-driven shovels, being laid out in a general east and west direction. These vats are about 200 feet in width by 600 feet in length. Water from wells sunk on the lake is pumped by centrifugal pumps into these vats and the bittern is recovered by solar evaporation. Crude salt is loaded by gasoline-driven shovels into motor trucks having a capacity of 10 tons each.

Saline Products Company salt plant, Briston Lake, near Amboy.

The trucks transport the salt across the lake to the plant. The rock salt is crushed, washed and screened in the plant, producing the following sizes: $\frac{1}{8}$-inch, $\frac{1}{4}$-inch and $\frac{1}{2}$-inch. The plant has a capacity of 100 tons of finished product per 10-hour day. Power to operate plant is developed by 200-h.p. Fairbanks-Morse diesel engine, directly connected to generator. Twenty-four men are employed at plant and pits.

SODA

Searles Lake, for many years an important source of borax and potash, is also the principal source of soda in the county. One plant, the West End Chemical Company, has been the principal producer of soda ash, which is recovered from the brines of Searles Lake.

Deposits of sodium sulphate occur at Dale Dry Lake near Dale, close to the southern boundry of San Bernardino and Riverside county. The occurrence of salt cake is also reported in the Dry Lake mining district 60 miles east of Victorville. It is also reported to

occur in the Old Dad Mountains, 10 miles southwest of Balch, a station on the Union Pacific Railroad.

Black Basin Sodium Sulphate Deposit. It comprises 10 claims situated in the Old Dad Mountains, 10 miles southwest of Balch, a station on the Union Pacific Railroad. Owner, C. W. Lipman, Story Building, Los Angeles.

A number of shallow prospect holes have been sunk in a wash which cuts across the claims. These holes have exposed 2 to 6 feet of sodium sulphate. Analysis shows 53% sodium sulphate.

Dale Dry Lake Deposit. This is the most important deposit of sodium sulphate in the county. The deposit is situated on Dale Dry Lake, 6 miles east of Dale and 15 miles east of Twenty-nine Palms. Holdings comprise about 1000 acres. Owner, J. E. Bush, Los Angeles, California.

Soda plant, West End Chemical Company, Searles Lake, San Bernardino County.

The salts leached out by rain water have formed a layer, usually very thin, but in places filling deeper channels. Under this crust is a mud layer containing considerable of the salines in solution. The deposit is principally sodium sulphate, but with crystals of blödite, the hydrous sulphate of magnesium and sodium, associated with it. The deposit can be easily mined, but the long haul of 40 miles to Amboy makes marketing the product a difficult problem. The deposit has been thoroughly prospected by the owner, Mr. Bush. Idle.

Emerson Sodium Sulphate Deposit. This deposit is situated in a Dry Lake, in what is known as the Dry Lake Mining district about 60 miles east of Victorville. Owner, Mrs. L. S. Emerson, Hodge, California. Samples taken from the deposit are reported to carry 46.5 per cent sodium sulphate.

West End Chemical Company. J. M. Smith, president; George C. Ellis, secretary; J. W. Sherwin, general manager; offices: Syndicate Building, Oakland, California.

The plant is on the west shore of Searles Lake, 4½ miles south of Trona. The property comprises about 2880 acres on Searles Lake. The concentrated brine is pumped from evaporation ponds to settling tanks. The brine from settling tank is pumped to 10 carbonate towers, 40 feet high by 8 feet in diameter, the process being to carbonate the liquors and so remove all of the sodium carbonate, as sodium bicarbonate or trona. This is filtered off and calcined to make soda ash.

The products produced in this plant are about 70 tons of soda ash per 24-hour day and about 25 to 30 tons of borax. Water to operate the plant is secured from springs located 17 miles west of the Lake. Dolomite to generate CO_2 gas is hauled by truck from a quarry owned by the company located north of Trona in Inyo County. Sixty-five men are employed.

STRONTIUM

Deposits of strontianite ($SrCO_3$) and celestite ($SrSO_4$) occur in San Bernardino County. Large deposits of celestite occur in the lake beds containing salt and gypsum in the Avawatz Mountains, on the holdings of the *Avawatz Salt and Gypsum Company,* Garland Building, Los Angeles. There is also a large deposit 4 miles north of Argos siding, on the Santa Fe Railroad and 6 miles from Ludlow. The beds of celestite are 12 feet to 20 feet thick. Strontianite, the carbonate, occurs in the clay beds 10 miles north of Barstow.

Bibl: State Mineralogist's Reports XV, pp. 898–899; XVII, pp. 366–367; U. S. Geol. Survey Bull. 540, pp. 526–531; 660-l.

TALC

Deposits of talc of commercial grade occur in the Avawatz Range of mountains and in the Shadow Mountains, northeast of Silver Lake; also southwest of Tecopa, east of the Amargosa River. The deposits in the Avawatz Mountains are undeveloped due to their distance from transportation.

The deposits in the vicinity of the Amargosa region, although they have been developed to a considerable extent, are idle at the present time, the only productive area being near Silver Lake, where the Tremolite Mine, operated by the Pacific Coast Talc Company of Los Angeles, has been an active producer since 1917. Over 80 per cent of the talc produced in California in 1928 was high grade talc from Inyo and San Bernardino counties, which material was utilized mainly in toilet powders, paint, paper and rubber manufacture and some in ceramics. It is reported that the talc produced in San Bernardino county is steadily replacing imported talc in the toilet trade on the basis of quality.

The crude talc produced by the Pacific Coast Talc Company is a pure silvery white and has a foliated texture. The ground product is a clear silvery white, with a very good slip, no grit, and very little lime.

Deposits.

Amargosa Group of Talc Mines. It comprises two claims, situated 1¼ miles south of Acme, a station on the Tonopah and Tidewater Railroad. The deposit occurs in Painted Canyon, west of the Amargosa River. Owner, W. H. Hite, and Thomas Coghland of Tecopa, California. A vein 2 to 10 feet in width occurs on contact of limestone and diorite.

The vein has a north and south course, dip 45° east. The talc is silvery white in color and said to have low lime content. Development consists of two tunnels. Fifty-five cars of high grade talc was shipped from the deposit in 1919. Idle.

Bibl: State Mineralogist's Report XVII, p. 367.

Acme Talc Mine. It is situated 7 miles east of Acme Siding on the Tonopah and Tidewater Railroad, and 8 miles southwest of Tecopa, in a range of hills east of the Amargosa River. Holdings comprise 6 claims. Owner, *Western Talc Company,* 1901 E. Slauson avenue, Los Angeles.

Deposits of pure white talc of good quality occur along a contact of limestone and diorite. The general strike of the ore deposits is N. 30° W., dip 45° E. The outcrop shows a width of 20 to 50 feet. Developments consist of tunnels and open cuts—the tunnels are from 200 to 500 feet in length. A large tonnage was produced from this property during 1919 and 1920, when it was operated by the *Pacific Minerals and Chemical Company,* Glendale, California. Eight men are employed. Ore mined is shipped to company's grinding plant at Los Angeles.

Bibl: State Mineralogist's Report No. XVII, p. 367.

Gould Talc Deposit. It is situated in T. 17 N., R. 10 E., 10 miles northeast of Silver Lake, on west slope of Shadow Mountains. Owner, George Novell of Los Angeles. The deposit lies on and near contact of limestone and diorite and can be traced along its outcrop for 3000 feet. The talc that occurs along this contact is from 5 to 8 feet wide, is white in color, and reported to have low lime content. Development consists of a number of shafts from 30 to 40 feet deep. Idle.

Bibl: State Mineralogist's Report XVII, p. 368.

Sheep Creek Deposits. These deposits are situated in the Avawatz Range of mountains, 12 miles west of Riggs, a station on the Tonapah and Tidewater Railroad. Owner, *Avawatz Salt and Gypsum Company,* Garland Building, Los Angeles.

The talc deposits of this region occur on contact of limestone and diorite. The talc is pure white to light gray in color, and varies in hardness from solid outcrops, which are moderately hard, to very soft crumbly masses. The fibrous and nonfibrous material, talc and tremolite, is silvery white in color and quite pure. The general strike of the outcrops that occur on Sheep Creek is northwest and southeast, and they vary in width from 15 to 35 feet.

There are four deposits in this region, three being on Sheep Creek and the fourth is northwest of the Jumbo-Salt deposit. The estimated tonnage that can be mined from these deposits is 400,000 tons. Idle.

Bibl: State Mineralogist's Reports XVII, pp.368–369; XVIII, pp. 114–115.

Talc Products Company Deposit. The deposit is situated in the Shadow Mountains, 2¼ miles east of Love Siding on the Tonopah and Tidewater Railroad. The deposit of talc occurs on the contact of limestone and diorite, which strikes northwest and southeast. The deposit has a thickness of 5 to 8 feet. The talc is slippery and foliated, pure white in color. Idle.

Bibl: State Mineralogist's Report XVII, p. 369.

Tremolite Mine (Pacific Coast Talc Company's Deposit). The property is situated on the northwest slope of Shadow Mountains, 10 miles northeast of Silver Lake and 7 miles southeast of Riggs, a station on the Tonapah and Tidewater Railroad. Elevation 2300 feet. Holdings comprise 14 claims, totaling 280 acres. Owner, *Pacific Coast Talc Company,* 2149 Bay street, Los Angeles. W. S. Lockhart, president; A. M. Algeo, secretary; George Ames, general manager.

The deposit of talc occurs in ferro-magnesium schists on or near the contact of limestone and diorite and has a general course of northwest and southeast, and can be followed along its outcrop for a distance of nearly one mile. The vein of talc dips 57 degrees south, and has a thickness of 5 to 10 feet, the ore occurring in irregular shoots. The talc mined is remarkable for its whiteness, mode of occurrence, and its origin. The crude talc is a pure silver white, with very good slip, no grit, and very little lime. The deposit has been developed by three incline shafts sunk on the vein on different portions of the property to depths of 120 to 150 feet; present work confined to a tunnel 1700 feet in length of which 1200 feet is driven on the vein. It is reported that there is about 50,000 tons of ore developed above the tunnel level. The ore mined from stopes above the tunnel level is trammed in cars to storage bin. The ore is hauled by motor truck to Riggs, the nearest shipping point, from which it is loaded in railroad cars and shipped to the company's grinding plant in Los Angeles. The grinding plant has a capacity of 20 tons per 10-hour day. The finished product is very high grade; it is extremely fine, has no grit; an excellent color; a very good slip, and adheres well to the skin. A typical analysis shows 0.31 per cent lime (CaO) and 0.28 per cent iron oxide. Products are utilized in the manufacture of talcum powder, roofing paper, paint trade, tiling and concrete admixture. Twelve men employed.

Bibl: State Mineralogist's Report XVII, pp. 369–370; U. S. B. M. Bulletin 213, pp. 116–117.

OIL FIELD DEVELOPMENT OPERATIONS

R. D. Bush, State Oil and Gas Supervisor

From March 30, 1930, to and including June 28, 1930, the following new wells were reported as ready to drill:

Company	Sec.	Twp.	Range	Well No.	Field
CONTRA COSTA COUNTY:					
Orinda Petroleum Co., Ltd.	32	1	3	1	
FRESNO COUNTY:					
R. S. Oiler	14	20	14	7	Coalinga
Richfield Oil Co.	33	22	16	Schrock 1	
KERN COUNTY:					
The Ohio Oil Co.	30	28	21	35	Belridge
The Ohio Oil Co.	30	28	21	36	Belridge
Richfield Oil Co.	22	27	20	Belridge 1	Belridge
Shell Oil Co.	24	28	20	Victoria 1	Belridge
Union Oil Co.	36	27	20	Gibson 6	Belridge
Nordon Oil Corp.	7	29	24	1	Buttonwillow Gas
Standard Oil Co.	36	30	24	Tupman 45	Elk Hills
George F. Getty, Inc.	23	29	27	Fairhaven 1	Fruitvale
Standard Oil Co.	26	29	27	Kern Co. Lease No. 5 4	Fruitvale
Western Gulf Oil Co.	22	29	27	Price & Stewart 1	Fruitvale
Bishop Corp.	23	28	27	18	Kern River
Bishop Corp.	26	28	27	McDonald 1	Kern River
C. C. M. O. Co.	23	28	27	34	Kern River
C. C. M. O. Co.	23	28	27	35	Kern River
Standard Oil Co.	15	28	27	23	Kern River
Standard Oil Co.	15	28	27	24	Kern River
Universal Consolidated Oil Co.	32	26	21	49	Lost Hills
Hugh B. Evans, Inc.	35	32	23	10	Midway
Republic Petroleum Co.	7	32	23	38	Midway
Standard Oil Co.	27	31	23	113	Midway
Standard Oil Co.	1	32	23	77	Midway
Standard Oil Co.	3	32	24	68	Midway
Standard Oil Co.	5	32	24	17	Midway
Standard Oil Co.	9	32	24	44	Midway
General Petroleum Corp.	16	27	28	Heisen 12	Mt. Poso
General Petroleum Corp.	16	27	28	Heisen 31	Mt. Poso
General Petroleum Corp.	21	27	28	Glide 21 14	Mt. Poso
General Petroleum Corp.	21	27	28	Glide 21 17	Mt. Poso
Pacific Western Oil Co.	15	27	28	Glide-Vedder 4	Mt. Poso
Pacific Western Oil Co.	15	27	28	Glide-Vedder 5	Mt. Poso
Pacific Western Oil Co.	15	27	28	Glide-Vedder 6	Mt. Poso
Pacific Western Oil Co.	15	27	28	Glide-Vedder 7	Mt. Poso
Pacific Western Oil Co.	22	27	28	King 6	Mt. Poso
Pacific Western Oil Co.	22	27	28	King 7	Mt. Poso
Petroleum Securities Co.	26	27	28	Gardner 4	Mt. Poso
Petroleum Securities Co.	26	27	28	Gardner 5	Mt. Poso
Fred M. Sayre	10	27	28	Sayre-Lawrence 1	Mt. Poso
West Coast Petroleum Combinations, Inc.	13	27	28	1	Mt. Poso
C. C. M. O. Co.	17	28	29	Olcese 1	Round Mountain
George F. Getty, Inc.	17	28	29	Olcese 1	Round Mountain
George F. Getty, Inc.	19	28	29	Jewett 1	Round Mountain
Honolulu Consolidated Oil Co.	18	28	29	99	Round Mountain
Shell Oil Co.	19	28	29	Jewett 3-3	Round Mountain
Shell Oil Co.	20	28	29	Freeman 8	Round Mountain
Shell Oil Co.	29	28	29	Jewett 12	Round Mountain
Barnsdall Oil Co.	8	11	23	Son-Crail 1	Sunset
Barnsdall Oil Co.	17	11	23	Hazelton 4	Sunset
California Western Oil Co.	17	11	23	Havenstrite 6	Sunset
General Petroleum Corp.	35	12	24	Moco 218	Sunset
Standard Oil Co.	5	11	23	24	Sunset
Standard Oil Co.	9	11	23	4	Sunset
Standard Oil Co.	9	11	23	47	Sunset

OIL FIELD DEVELOPMENT OPERATIONS—Continued

Company	Sec.	Twp.	Range	Well No.	Field
KERN COUNTY—Continued					
Continental Oil Co.	6	29	30	Williams 1	
Rio Cal. Petroleum Corp., Ltd.	2	27	18	Belridge-Carney 1	
Dr. J. J. Ritchie	33	11	19	1	
Shell Oil Co.	17	27	23	Williams 1	
Shell Oil Co.	23	28	26	Lee 1 1	
W. W. Stabler	4	11	18	Southwest 1	
Union Oil Co.	8	11	24	N. & F. 2	
J. Benson Wrenn, et al	32	25	17	1	
KINGS COUNTY:					
Petroleum Securities Co.	35	21	17	Felix 2	Kettleman Hills
Shell Oil Co.	36	21	17	Dixon 1	Kettleman Hills
Standard Oil Co.	35	21	17	47	Kettleman Hills
LOS ANGELES COUNTY:					
Standard Oil Co.	8	2	14	L. A. Invest-ment 1 63	Inglewood
Standard Oil Co.	17	2	14	Vickers 1 24	Inglewood
Armadillo Oil Co., Ltd.	13	4	13	1	Long Beach
Walter T. Ball No. 1	19	4	12	Walter T. Ball 1	Long Beach
Ball & Barnes No. 1, Ltd.	13	4	13	1	Long Beach
R. R. Bush Oil Co.	13	4	13	26	Long Beach
Carter Petroleum Co., Ltd.	13	4	13	1	Long Beach
Chessman and Riner	29	4	12	Stockwell 1	Long Beach
Chiksan Oil Co., Ltd.	13	4	13	Wolter 1	Long Beach
Cumming Petroleum, Ltd.	29	4	12	1	Long Beach
Cumming Petroleum, Ltd.	13	4	13	Kittle 1	Long Beach
Dabney-Johnston Oil Corp.	18	4	12	74	Long Beach
Dabney-Johnston Oil Corp.	19	4	12	43	Long Beach
Dabney-Johnston Oil Corp.	29	4	12	53	Long Beach
Dabney-Johnston Oil Corp.	24	4	13	57	Long Beach
Davis Investment Co.	29	4	12	16	Long Beach
Dukette & Pelissier	13	4	12	1	Long Beach
Fred Fitch	13	4	13	2	Long Beach
H. G. Fox	24	4	13	1	Long Beach
George F. Getty, Inc. and J. Paul Getty	19	4	12	L. B. 29	Long Beach
Glengarry Petroleum Co., Ltd.	24	4	13	McMarr 1	Long Beach
Graham-Loftus Oil Corp.	24	4	13	4	Long Beach
Graham-Loftus Oil Corp.	24	4	13	5	Long Beach
R. L. Haley & J. F. Corbett	13	4	13	Haley & Corbett 1	Long Beach
Otis Hoyt	29	4	12	11	Long Beach
Otis Hoyt	30	4	12	12	Long Beach
F. H. Lathrap	13	4	13	Lathrap 1	Long Beach
M. and A. Oil Co., Ltd.	29	4	12	Painted Hills 1	Long Beach
A. N. Macrate	29	4	12	Britch 1	Long Beach
Mammoth Oil Co., Ltd.	13	4	13	1	Long Beach
Mendin Oil Co., Ltd.	13	4	13	1	Long Beach
C. W. Murphy	24	4	13	2	Long Beach
A. L. Paine, Trustee	29	4	12	1	Long Beach
Petroleum Securities Co.	29	4	12	Painted Hills 2	Long Beach
Petroleum Securities Co.	13	4	13	Bixby 3	Long Beach
Plymouth Oil Co.	29	4	12	10	Long Beach
Plymouth Oil Co.	29	4	12	11	Long Beach
Plymouth Oil Co.	29	4	12	12	Long Beach
Rawco, Inc., Ltd.	29	4	12	Rawco 6	Long Beach
George R. Rider	24	4	13	1	Long Beach
O. J. Rinebarger	29	4	12	1	Long Beach
Safeway Oil Co., Ltd.	13	4	13	1	Long Beach
Signal Oil and Gas Co.	29	4	12	Signal-Goodyear 1	Long Beach
George N. Snyder	13	4	13	1	Long Beach
Standlee Oil Co.	13	4	13	1	Long Beach
Tri State Petroleum Corp., Ltd.	19	4	12	2	Long Beach
Benago Petroleum Co., Ltd.	13	4	12	1	Long Beach
Vesta Petroleum Co.	18	4	12	5	Long Beach
Vesta Petroleum Co.	13	4	13	4	Long Beach

OIL FIELD DEVELOPMENT OPERATIONS—Continued

Company	Sec.	Twp.	Range	Well No.	Field
LOS ANGELES COUNTY—Contd,					
S. S. Wortley	13	4	13	1	Long Beach
Zenith Oil Co., Ltd.	13	4	13	3	Long Beach
Southern California Drilling Co.	13	3	16	Needham 3	Newhall
Allied Petroleum Corp.	21	2	15	Rawco-Woodford 1	Playa del Rey
Barnsdall Oil Co.	21	2	15	Burks 1	Playa del Rey
Barnsdall Oil Co.	21	2	15	Burks 3	Playa del Rey
C. C. Beem	28	2	15	Dell'Acqua 1	Playa del Rey
Deuel Petroleum Corp., Ltd.	21	2	15	Deuel 1	Playa del Rey
Joseph M. Devere	21	2	15	Baby Jo 1	Playa del Rey
El Camino Oil Co., Ltd.	21	2	15	1	Playa del Rey
The Elmer Co., Ltd.	21	2	15	1	Playa del Rey
The Elmer Co., Ltd.	21	2	15	2	Playa del Rey
The Elmer Co., Ltd.	21	2	15	3	Playa del Rey
George F. Getty, Inc.	21	2	15	V. 1	Playa del Rey
A. T. Jergins Trust	21	2	15	Robertson 1	Playa del Rey
Knickerbocker Petroleum Co.	21	2	15	1	Playa del Rey
McDonald Petroleum, Ltd.	21	2	15	1	Playa del Rey
McDonald Petroleum, Ltd.	21	2	15	2	Playa del Rey
Mohawk Petroleum Co.	28	2	15	J. 1	Playa del Rey
The Mutual Oil Co.	21	2	15	1	Playa del Rey
The Ohio Oil Co.	28	2	15	Block J 1	Playa del Rey
Santa Fe Springs Oil Co.	21	2	15	Venice 1	Playa del Rey
Star Petroleum Co.	21	2	15	V. 1	Playa del Rey
Star Petroleum Co.	21	2	15	V. 2	Playa del Rey
Superior Oil Co.	28	2	15	Moses 1	Playa del Rey
York-Smullin Oil Co.	21	2	15	Jones & Prentiss 1	Playa del Rey
Associated Oil Co.	34	2	14	Potrero 3	Potrero
George F. Getty, Inc.	28	2	14	P. 2	Portero
George F. Getty, Inc.	28	2	14	P. 4	Potrero
Hugh Grant	28	2	14	Grant-Inglewood 5	Potrero
Heltur Oil Co., Ltd.	28	2	14	1	Potrero
Lyon & Bassett	28	2	14	Lyon & Bassett 1	Potrero
McAdams Oil Syn.	28	2	14	McAdams 1	Potrero
Edwin A. McKanna	28	2	14	1	Potrero
Richfield Oil Co.	28	2	14	Runnells 1	Potrero
Richfield Oil Co.	28	2	14	Sloan 1	Potrero
Taylor Oil Co., Inc.	28	2	15	1	Potrero
Don L. Francis	8	3	13	1	Rosecrans
McMahon & McDonald	12	3	14	1	Rosecrans
Tri State Petroleum Corp., Ltd.	12	3	14	3	Rosecrans
Union Oil Co.	18	3	13	Rosecrans 13	Rosecrans
Union Oil Co.	18	3	13	Rosecrans 14	Rosecrans
Union Oil Co.	19	3	13	Rosecrans 15	Rosecrans
Mohawk Petroleum Co.	6	3	11	Hathaway 6	Santa Fe Srpings
The Texas Co.	6	3	11	Matern Three 16	Santa Fe Springs
California Ventura Oil Co.	31	3	14	1	Torrance
Bardeen Petroleum Co., Ltd.	9	2	10	Puente 1	
Lamona Oil Association	34	1	9	1	
Republic Petroleum Co.	10	3	14	1	
Union Oil Co.	10	3	11	Orchardale Comm. 1-1	
Western American Petroleum Co.	14	2	10	1	
ORANGE COUNTY:					
Union Oil Co.	2	3	10	Naranjal 15	Brea-Olinda
Standard Oil Co.	18	3	10	Murphy-Coyote 103	Coyote Hills
Standard Oil Co.	19	3	10	Murphy-Coyote 104	Coyote Hills
Standard Oil Co.	19	3	10	Murphy-Coyote 105	Coyote Hills
Standard Oil Co.	13	3	11	Emery 47	Coyote Hills
Standard Oil Co.	12	6	11	Thompson 12	Huntington Beach
Stevely & Gooden, Inc.	10	6	11	Fee 1	Huntington Beach
Vaqueros Major Oil Co., Ltd.	32	5	11	1	Huntington Beach
West American Oil Co.	2	6	11	Golden Dome Ward 1	Huntington Beach

OIL FIELD DEVELOPMENT OPERATIONS—Continued

Company	Sec.	Twp.	Range	Well No.	Field
ORANGE COUNTY—Continued					
Arrowhead Oil Co.	33	3	9	Gatewood 1	Richfield
Continental Oil Co.	33	3	9	Ross-Schlachter 2	Richfield
Continental Oil Co.	33	3	9	Santa Fe 4	Richfield
Louis C. Simmel	21	3	9	1	Richfield
Standard Oil Co.	26	6	10	Irvine Company 1	
SAN BERNARDINO COUNTY:					
C. C. Hamilton	11	10	5	1	
SAN LUIS OBISPO COUNTY:					
J. D. Martin	5	32	13	Pricco A-1	Arroyo Grande
J. D. Martin	5	32	13	Pricco C-1	Arroyo Grande
SANTA BARBARA COUNTY:					
Barnsdall Oil Co.	9	8	32	Tognazzini 1	Cat Canyon
Bankline Oil Co.	15	4	29	89-4	Elwood
Bankline Oil Co.	15	4	29	89-6	Elwood
Barnsdall Oil Co.	15	4	29	Luton-Bell 13	Elwood
Barnsdall Oil Co.	15	4	29	Luton-Bell 15	Elwood
Barnsdall Oil Co.	15	4	29	Luton-Bell 16	Elwood
Barnsdall Oil Co.	16	4	29	88-3	Elwood
Bolsa Chica Oil Corp.	25	4	29	191-2	Elwood
J. H. Cochran	7	4	29	7	Elwood
Elwood Exploration Co.	22	4	29	90-3	Elwood
Elwood Exploration Co.	22	4	29	90-4	Elwood
Elwood Exploration Co.	22	4	29	90-8	Elwood
Pacific Western Oil Co.	16	4	29	92-5	Elwood
Ring Oil Co., Ltd.	16	4	28	Moore 1	Elwood
Signal Oil & Gas Co.	16	4	29	Signal Appleford 2	Elwood
Caroline C. Spalding	16	4	29	Blue Goose 93-4	Elwood
Vaqueros Major Oil Co., Ltd.	6	7	33	1	Lompoc
H. H. Barnes	28	4	27	1	
Deuel Petroleum Corp., Ltd.	10	7	30	1	
General Petroleum Corp.	5	4	30	Erburu 5	
General Petroleum Corp.	32	5	30	Erburu 4	
General Petroleum Corp.	32	5	30	Erburu 6	
Shell Oil Co.	31		30	Orella 1	
Standard Oil Co.	26	4	25	Shepard 2	
Valemont Oil Co., Ltd.	28	4	27	Birdie Cline 1	
SANTA CRUZ COUNTY:					
Alan W. Rispin	14	11	2	1	
VENTURA COUNTY:					
Camarillo Oil Syn.	33	2	20	1	Conejo
A. H. McFarland & Co.	33	4	18	3	Piru
D. M. Ekstrom	21	3	24	87-1	Rincon
F. T. Fuller	17	3	24	84-1	Rincon
Indian Petroleum Corp.	12	3	25	Boone 1	Rincon
J. W. Maddrill	16	3	24	86-1	Rincon
Neil C. Needham	7	3	24	Needham 1	Rincon
J. H. Raney	17	3	24	85-1	Rincon
Rincon Oil Co.	7	3	24	Shudde 1	Rincon
Sea Cliff Development Co., Ltd.	7	3	24	56-1-A	Rincon
G. C. Thompson	15	4	21	1	Santa Paula
Oil Search Corp., Ltd.	29	4	19	1	Sespe
Associated Oil Co.	26	3	23	Lloyd 40	Ventura
Associated Oil Co.	26	3	23	Lloyd 89	Ventura
Associated Oil Co.	26	3	23	Lloyd 95	Ventura
Associated Oil Co.	26	3	23	Lloyd 96	Ventura
Shell Oil Co.	20	3	23	Taylor 61	Ventura
Shell Oil Co.	29	3	23	Taylor 57	Ventura
Shell Oil Co.	29	3	23	Taylor 58	Ventura
Shell Oil Co.	29	3	23	Taylor 62	Ventura
Shell Oil Co.	29	3	23	Taylor 63	Ventura
Shell Oil Co.	14	2	20	Everett 1	

GEOLOGIC BRANCH

By Olaf P. Jenkins, Chief Geologist

Progress Report.

The plan for summer geological field work, as outlined in the April quarterly chapter of the State Mineralogist's report, is now being carried out. Twelve field parties are busy—in northern, central and southern California—and much is being accomplished.

In reviewing and evaluating the detailed and semi-detailed geologic map work already done in California, the Chief Geologist has estimated that 26 per cent of the state is covered by published geologic maps, 32 per cent by unpublished maps, while 42 per cent remains practically blank. The total available material for the new geologic map of California, now in process of preparation, is therefore 58 per cent. This area, however, is not all covered with sufficient detail or accuracy to be adequate for publication at the present time and much of it must be checked over or entirely remapped.

The U. S. Geological Survey is cordially supporting the State Division of Mines by pressing forward the compilation of the state geologic map, and the preparation of a bulletin on the geologic formational units of California.

The days when sketchy work or reconnaissance mapping was of value are gone. Now the demand is for care and accuracy in mapping geological formations and for special application of this fundamental knowledge to the economic study of the mineral deposits of the country. It is the recommendation of the Chief Geologist that detailed geology only be planned for future expenditures in the field by the state organization, and this type of geology can be properly done only where there are adequate topographic base maps available. There are large areas, especially in parts of northwestern California, which lack these accurate base maps, or topographic quadrangles. In these unmapped areas, therefore, much preliminary work should be done before the geologist may start to work. There are, however, a large number of good topographic maps available in various parts of the state which have not yet been studied geologically, and it will be to these areas that the geologists will first bring their attention.

Many travelers are interested in the geologic features along the highways. It is planned that geologic strip maps with explanatory descriptions be issued covering some of the more interesting stretches of country.

Within the next year the division expects to issue geologic reports prepared by very competent geologists on the following areas:

Weaverville quadrangle.
Shasta quadrangle.
Sebastopol and Duncans Mills quadrangles.
Mt. Morrison and Mt. Lyell quadrangles.
Searles Lake quadrangle.
Elizabeth Lake quadrangle.
San Jacinto quadrangle.
Marble Mountains of San Bernardino County.
Newberry Springs Mountains of San Bernardino County.

The Bibliography of the Geology of California is in press. Several other geologic projects have also been started. One is the underground geology of the Grass Valley mining region. Another is the underground geology of the region cut by the coast tunnels of the Hetch Hetchy aqueduct.

Since the work of the Geologic Branch of the Division of Mines has a scope much broader than just that of mapping the surface formations, the State Mining Board has decided to call the newly established branch a *Geological and Economic Mineral Survey.* Some of the various lines of work which will come under its supervision are listed as follows:

1. Ore-genesis. The study of the origin and finding of ores.

2. Study of underground water supply.

3. Economic geology of nonmetallics, such as limestone, diatomite, clays, etc.

4. Geology of mineral fuels. In California this consists principally of oil geology.

5. Geologic investigation of foundations to such structures as dams, bridges, etc.

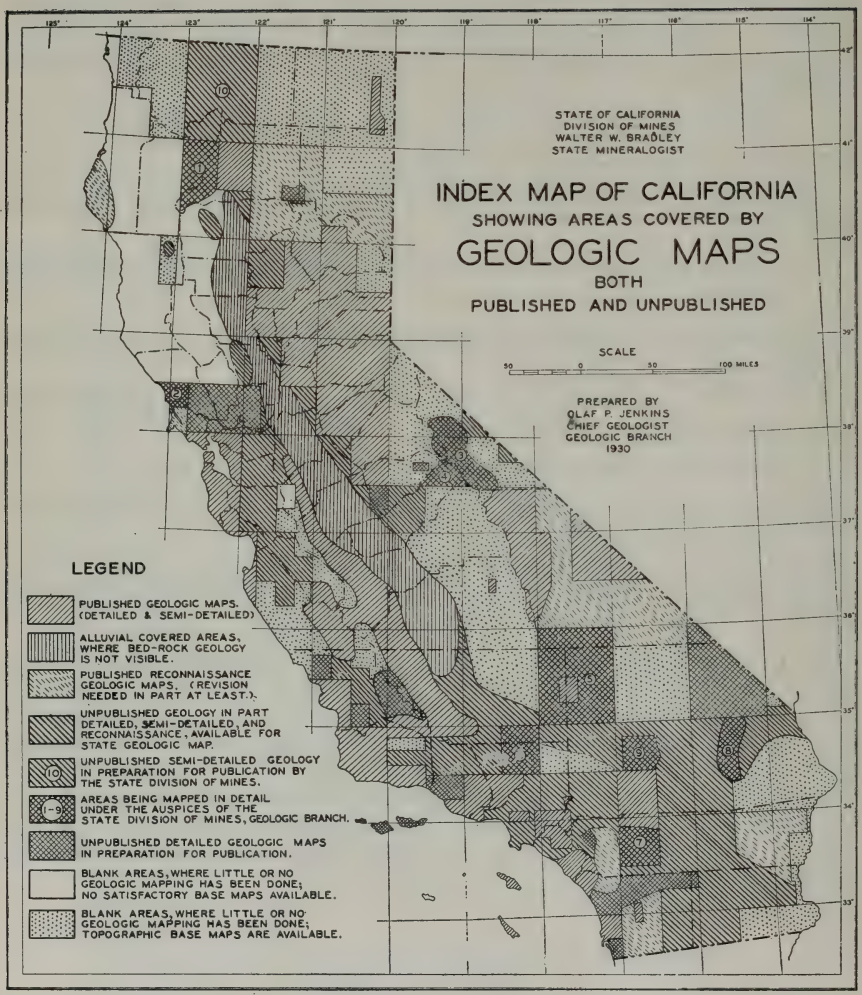
6. The study of earthquakes and active faults, in their general relation to the construction of buildings.

7. The study of the geologic conditions relative to soils.

8. The special study of the geology of the national parks with popular accounts for tourists.

9. Geologic study of the surface features or the physiography of the state, a subject not only of special interest in the schools but of great service in the general interpretation of topography.

It is greatly desired that the Geological and Economic Mineral Survey of the Division of Mines act as a clearing house for geological knowledge of California; therefore, it calls for continued cooperation in bringing together all data to this one central head. The ultimate plan is to make available through publication all this interesting and valuable information. The development of the mineral industries of the state may be greatly enlarged through the aid of the scientific ground work afforded by the practical application of fundamental geological knowledge.


STATE OF CALIFORNIA
DIVISION OF MINES
WALTER W. BRADLEY
STATE MINERALOGIST
INDEX MAP OF CALIFORNIA
SHOWING AREAS COVERED BY
GEOLOGIC MAPS
BOTH
PUBLISHED AND UNPUBLISHED
SCALE
50 0 50 100 MILES
PREPARED BY
OLAF P JENKINS
CHIEF GEOLOGIST
GEOLOGIC BRANCH
1930
LEGEND
PUBLISHED GEOLOGIC MAPS. (DETAILED & SEMI-DETAILED)
ALLUVIAL COVERED AREAS, WHERE BED-ROCK GEOLOGY IS NOT VISIBLE.
PUBLISHED RECONNAISSANCE GEOLOGIC MAPS. (REVISION NEEDED IN PART AT LEAST.).
UNPUBLISHED GEOLOGY IN PART DETAILED, SEMI-DETAILED, AND RECONNAISSANCE; AVAILABLE FOR STATE GEOLOGIC MAP.
(10) UNPUBLISHED SEMI-DETAILED GEOLOGY IN PREPARATION FOR PUBLICATION BY THE STATE DIVISION OF MINES.
(1-9) AREAS BEING MAPPED IN DETAIL UNDER THE AUSPICES OF THE STATE DIVISION OF MINES, GEOLOGIC BRANCH.
UNPUBLISHED DETAILED GEOLOGIC MAPS IN PREPARATION FOR PUBLICATION.
BLANK AREAS, WHERE LITTLE OR NO GEOLOGIC MAPPING HAS BEEN DONE; NO SATISFACTORY BASE MAPS AVAILABLE.
BLANK AREAS, WHERE LITTLE OR NO GEOLOGIC MAPPING HAS BEEN DONE; TOPOGRAPHIC BASE MAPS ARE AVAILABLE.

Further Explanation of Index Map Evaluating Geologic Work Done.

The numbers (1 to 10) refer to projects under way by the California State Division of Mines, Geologic Branch. They are as follows:

(1) A detailed geologic survey of the Weaverville quadrangle (in Trinity and Shasta counties) by Dr. N. E. A. Hinds, Assistant Professor of Geology, University of California.

(2) A detailed geologic survey of the Sebastopol and Duncans Mills quadrangles which lie west of the Santa Rosa quadrangle (in Sonoma and Marin counties) by Mr. F. A. Johnson of the University of California.

(3) A detailed geologic survey of an area on the east flank of the Sierra Nevada in Mono County by Mr. Evans B. Mayo, formerly of Stanford University but now of Cornell University.

(4) A detailed geologic survey and study of the mineral deposits of the Minarets District in northeastern Madera County by Mr. Homer Erwin of the University of California.

(5) A detailed geologic survey of the Searles Lake quadrangle (in San Bernardino, Inyo and Kern counties) by Dr. Carlton D. Hulin, Associate Professor of Geology, University of California.

(6) A detailed geologic survey of Elizabeth Lake quadrangle (in Los Angeles and Kern counties) by Mr. Edward C. Simpson of the University of California.

(7) A detailed geologic survey of the San Jacinto quadrangle south of San Gorgonio Pass (in Riverside County) by Mr. Donald M. Fraser of Columbia University.

(8) A detailed geologic study of an area in San Bernardino County, including the Ship, Marble and Providence mountains, by Mr. John C. Hazzard of the University of California.

(9) A detailed geologic survey of an area in San Bernardino County, including the Newberry Mountains, by Mr. Dion Gardner of the University of California.

(10) A geologic study of the Shasta quadrangle (in Siskiyou, Shasta and Trinity counties), with special reference to economic developments, by Mr. Charles V. Averill, District Mining Engineer of the State Division of Mines. An areal geologic map of the Shasta quadrangle has been supplied by the geological department of the Southern Pacific Company and Mr. Averill is coordinating this work with that of his own.

Besides these ten projects, there are two others dealing with underground geology. They are as follows:

(11) An underground geologic study of the deeper mine workings in the Grass Valley district by Mr. Robert L. Loofbourow of Stanford University who is working as an assistant to the U. S. Geological Survey in a cooperative arrangement with the state.

(12) An underground geologic study of the coast tunnels of the Hetch Hetchy aqueduct (San Joaquin and Alameda counties) by Mr. George L. Green of Stanford University. This work is being done under the auspices of the Division of Mines, through a cooperative arrangement with the City Engineer of San Francisco.

SPECIAL ARTICLES

Detailed technical reports on special subjects, the result of research work on extended field investigations, will continue to be issued as separate bulletins by the Bureau, as has been the custom in the past.

Shorter and less elaborate technical papers and articles by members of the staff and others are published in each number of 'Mining in California.'

These special articles cover a wide range of subjects both of historical and current interest; descriptions of new processes, or metallurgical and industrial plants, new mineral occurrences, and interesting geological formations, as well as articles intended to supply practical and timely information on the problems of the prospector and miner, such as the text of the new laws and official regulations and notices affecting the mineral industry.

COMMERCIAL GRINDING PLANTS IN CALIFORNIA

The industrial mineral or commercial mineral has to be put in such a form that the consumer can use it. Some of these materials are mined in a sufficiently pure form for the market, although most require further treatment before marketing. The material, as it comes from the mine, varies in size from large pieces to a powder, while the user requires a product of uniform size and in a form to suit his particular requirements. To obtain such a product requires a grinding, classifying and mixing plant. The average mining operation for such mineral raw materials does not justify the construction of such a plant at the mine nor does the average user's consumption; therefore, commercial plants have been constructed in or near industrial centers to supply the needs of both the producer and the user. One plant can supply the needs of a fairly large circle of both, also most of the owners of these plants produce and market several mineral products.

Up to the last few years, at least, production in California has been in the majority of instances dependent upon more or less of a strictly local market with wide variation from year to year in both price and amount. Lately with increasing uses and a wide demand for such material the market is gradually becoming stable and the producer has more or less of a market for the mineral he produces.

The average producer of this type material mines from one car a year to several cars a month. The mineral goes to a mill which is usually located in one of the larger manufacturing centers, as the San Francisco Bay area or Los Angeles, for several reasons. As the freight rate is less on the crude material, supplies can be obtained from several places. The mill is either close to the user or to cheap water transportation for the east coast or export purposes.

The production of this type of mineral product has been showing a steady increase with many new minerals being added to the list as new users are found for the particular product, and undoubtedly others will be found for many that are now considered useless. Under the minerals classed in the 'Industrial Group' in California, the production

has increased from $1,721,943 in 1913 to $7,565,147 in 1929. This does not include some minerals that are listed under one of the other statistical groups, but owing to a particular use require preparation in a grinding mill before being placed on the market

NORTHERN CALIFORNIAN PLANTS

By Henry H. Symons, Mining Engineer

American Bleaching Clay Co. This mill is located at 615 University avenue, Berkeley. Owner, A. W. Paulson. This was formerly the plant of Geo. A. Moore & Co.

Situated on a spur of Southern Pacific Railroad. This mill is especially adapted for materials that require wet grinding or concentrating. Both metallic ores and nommetallic minerals have been handled here and now the mill is being remodeled to do straight grinding as well as concentrating.

Under the previous owner the mill was used to concentrate graphite, zinc, lead and copper ores. The present company intends to continue this as well as grind bleaching clay, talc, barytes and other minerals. The plant has a daily capacity of 25 tons. They specialize on producing a nonacid bleaching clay for all edible oils.

The equipment and approximate flow sheet is as follows: From the car the material goes to No. 3 Blake crusher, to a 12″ bucket-belt elevator, to storage bins. From the ore bin the material goes to a Joshua Hendy 5′ x 6′ ball mill in closed circuit with a Dorr classifier, the overflow from classifier goes to 16-cell Minerals Separation flotation machine, and the concentrates go to two 8′ Callow flotation machines used as cleaners. The tailings from the M. S. machine go to the bay. The tailings from the Callow machine return to the head of the M.S. machine or to the bay as material, being handled, requires. The concentrates from the Callow machine go to a 20′ Dorr thickener tank, to a 20-disc American continuous filter. If complete dryness is required the material then goes to a 3′ x 25′ external rotary dryer. This is followed by a beater mill equipped with air system and dust collectors.

American Development Co. Main office, 313 Financial Center Bldg., San Francisco. Verne H. Carter, president and general manager. H. T. James, secretary. Geo. D. Gleason, superintendent of mill.

The mill is situated on Sixth street, near Gilman street, Berkeley, having a spur from Southern Pacific Railroad. This plant is new and not completed as yet, although most of the machinery is now on the ground. It is designed for grinding of any nonmetallic mineral for the trade and is equipped to handle it either by a dry or wet method of grinding and for such materials as talc, magnesite, soapstone, barytes, filtering clay, fluorspar, lime rock and calcium carbonate. The plant will have a capacity up to 150 tons a day.

The material is unloaded from the car into a concrete bin underneath the track; from here it goes into a skip to the primary crusher—a 10″ x 16″ Blake, which is situated on top of the storage bin. This bin is divided into four compartments and has a total capacity of 700 tons. From the storage bins the material passes through 12″ x 24″ rolls to an elevator over a screen; oversize can then be returned to rolls,

fine can be sent to either Raymond mill, Hardinge pebble mill, or (Huntington mill or Gates tube mill or to jig and tables, to dewatering classifier, to Kihl mill or flotation).

The Raymond mill is 5-roller Kihl type equipped with dryer heated by natural gas and having an air system with dust collector in closed circuit. The storage bin at the bottom of the dust collector is equipped with sacking device.

Exterior and interior views of American Development Company's grinding plant, Berkeley, California.

The Hardinge pebble mill is 5′ silex-lined, to grind such material as should be iron free.

The above portion of the mill is now in operation while the following units are still in the course of construction:

For materials needing cleaning they are taken from rolls to an 8-cell Missouri-type jig or over a Wilfley table, the concentrates to a dewatering classifier, to Kihl mill or after fine grinding can be sent to 4-cell Krout flotation machine; concentrates to classifier and Kihl mill. This

mill is equipped with dryer and is also useful in the handling of clay which can be ground and dried in a single operation.

They also have a 5′ x 2′-4″ Gates mill, 5′ Huntington mill and small Hardinge ball mill as well as Oliver filter, cone and bleaching tank, Colorado Iron Works screen for all mills, and a magnetic separator which will be placed after rolls.

The plant when complete will require a total of 350 electrical horsepower and will employ about ten men.

American Mineral Products. Located on the Southern Pacific track just south of Powell street, Emeryville. Owners, E. W. Harker and H. E. Steele.

This plant is a fine-grinding mill and is equipped to handle such materials as barytes, talc, magnesite, marble dust, quartz, high-temperature cement, graphite, abrasives and similar minerals, having a capacity of 2½ tons per hour through 200 mesh.

The material is handled through the plant as follows: The material passes from the car to a hopper, to a bucket elevator, to a No. 4 Wheeling crusher into a storage bin. From the bin the material goes to a Giant Griffon mill, to a vibrating screen, the fines going to air separator and dust collector, the oversizes from both returning to the Griffon mill. The fine material passes into a hopper at the bottom of the dust collector where it is sacked. The plant is also equipped with a 2′ x 20′ rotary drier and at present they are installing an additional Griffon mill.

The present plant requires about 150 horsepower in electric motors and employs four men.

Walter S. McLean. Crown Ore Mills. Located at 1919 San Bruno avenue, San Francisco. Owner, Walter S. McLean. This is the oldest plant of this type in California, having been established in 1895 by Albert Pick. The plant was then located on Brannan street and remained there until seven years ago, when it was moved to its present site. Pick operated the plant until 1915, when McLean took it over.

This mill has a spur from the Western Pacific industrial track, and is now producing various colored granules for terrazzo, stucco and roofing, marble and brick dust; grinds clay, soapstone, and all types of industrial minerals.

From the car the material goes to a primary 8″ x 12″ Hercules rock breaker (Blake type), crushed to 2″ size, going to an 8″ bucket belt elevator to 14″ conveyor belt, which takes it to either No. 1, 2 or 3 storage bin, each having a capacity of 100 tons.

Unit No. 1. This unit handles colored material. From ore bin the rock passes to 6″ x 8″ Hendy crusher (Dodge type), crushing to ½″, to elevator over a double-deck shaking screen, having 4 different mesh and making 4 different finished products. The oversize goes to a set of 10″ x 12″ rolls, to elevator, to screen.

Unit No. 2. This unit handles white material and is identical to Unit No. 1, only the material from first section of screen can go on conveyor belt to bin No. 4 for Unit No. 3.

Unit No. 3, for real fines. From storage bin the material goes through an automatic feeder to a 3′ Hardinge ball mill, then to elevator to a 100-mesh reel 15′ long and 1′-6″ in diameter, the fines going to a

storage bin equipped with sacking devices, the oversize returning to ball-mill feeder.

The plant has also a buhr mill for grinding.

Red granules unit. This unit is entirely separate from above described units. The material comes from car to crude material storage bin, to 8″ x 12″ Hendy crusher (Dodge type), to an elevator over 4 sets of vibrating screens, oversize going to 2 sets of rolls returning to elevator to screens, the entire operating plant being controlled by special air system and dust collector. The screened product goes automatically to a 50-ton storage bin, while the dust is sent to a 35-ton storage bin.

The plant has 22,000 sq. ft. of storage space and all is well ventilated. The plant uses 150 horsepower and has a daily capacity of 15 to 50 tons, depending on material. Employs two men.

Pacific Mineral Co., Ltd. Officers of the company are Charles S. Renwick, president, and T. H. De Lap, secretary. Head office, 337 Tenth street, Richmond, California. This company has three plants in California equipped for crushing materials to small size. They handle mostly their own material, owing to location of plant. The materials handled are slate, greenstone and red rock for granules, barytes and soapstone.

Angels Greenstone Plant.

The Angels greenstone granule plant (C. M. Devore, superintendent) is located about one-quarter mile south of Angels Camp, Calaveras County, adjacent to the state highway. Crude greenstone is mined at a depth of 200 feet below surface, from where it is hoisted and trammed directly into the crude-ore bunkers where it passes through three sets of jaw crushers and three sets of smooth-shell crushing rolls. Vibrating screens are placed at different points in the circuit to remove dust and regulate the sizing of the material to customers' requirements. The plant is operated by electric power and the spur track that connects with the main line of the Sierra Railroad runs into the plant storage bins. This plant has been operating for the past ten years. In the mine drilling is done by compressed air and the pillar and stope method is practiced.

Placerville Plant.

The Placerville granule plant (William A. Gebhardt, superintendent) is located at Chili Bar on the American River about three miles from the town of Placerville, El Dorado County. The mill consists of two Williams mills with three banks of hummer screens to remove dust and obtain proper-sized granules. The mine is adjacent to the mill from where crude black slate is trammed directly into the Williams crusher. The plant is operated by electric power. Mining is done by air-hammer drilling, pillar and stope method.

Barstow Crushing Plant.

The Barstow plant (Charles Jenkins, superintendent) is located about one-quarter mile east of the Barstow Harvey House adjacent to the main line tracks of the Santa Fe Railroad. At present this plant

is operating intermittently between crushing and concentrating barytes and crushing red rock for roofing granules. Crude material is delivered from gondolas directly into the primary rock crusher and is then hoisted into the crude-ore bunkers to be fed later into the Symons cone crusher and again elevated by conveyor to the screen room of the fine-grinding building where it passes over screens and into two sets of smooth-shelled rolls and elevated again to be rescreened and sized, later to be deposited in the finished product storage bins from where it can be drawn off directly into box cars for shipment.

Sinclair-Wolfe Co. This mill is located at foot of Twenty-second avenue, Oakland. Owners, R. A. Sinclair and Thomas H. Wolfe. This plant was originally owned and operated by the Hoff Magnesite Co.

The plant is situated on a Southern Pacific spur track at Pacific Steel Station and only a few hundred feet from Oakland Estuary for water transportation. It is equipped for either crushing to given size

Grinding plant of Sinclair-Wolfe Co., Oakland, California.

or for fine grinding, having a capacity of 2 tons per hour through 200 mesh, and the handling of such mineral as asbestos, magnesite, roofing-granules, talc, soapstone, graphite, barytes, chromite, bleaching clay or any similar materials.

As regards the handling of material through the plant, the flow sheet is: The materials are unloaded direct from the car to a hopper feeding a jaw crusher of Dodge type with 12″ x 12″ opening, crushing to one-inch size. The crushed material is elevated to a storage bin by a 12″ bucket-belt elevator equipped with magnetic pulley to remove stray iron and steel. For fine grinding the material passes from the bin to a Williams universal hammer mill equipped with air system and dust collectors which remove 100-mesh and finer, the average going to a No. 2 French buhrstone mill also equipped with air system; the oversize from hammer mill goes to a worm conveyor which takes it to an 8″ bucket-belt elevator to 3′ x 6′ vibrating screen, the material through the screen going to the buhr mill while the oversize is returned to the hammer mill. In the coarse-grinding system the material passes from

a storage bin to a Grundler hammer mill equipped with air system, which can be used when handling asbestos. The air system removes the asbestos when it is freed from the rock, the coarse particles of rock pass out of machine, the dust is removed from the asbestos in air system; or, for coarse grinding, such as roofing granules, the material passes from the hammer mill to 8″ bucket-belt elevator to 3′ x 8′ double-deck shaking screen. The oversize can be returned to the hammer mill. For making various mixtures there is a one-ton Broughton dry mixer to which the desired ingredients are fed.

About 100 horsepower (electric) is required. Three men are employed.

Bibl: State Mineralogist's Report XVIII, p. 143.

Synthetic Iron Color Co. This plant is located at Pennsylvania and D street, Richmond. Address P. O. Box 1157, Richmond. President and general manager, N. M. Zoph; secretary, M. H. Zoph. This plant is primarily for the manufacture of pigments for the paint trade, but

Plant of Synthetic Iron Color Co., Richmond, California.

does custom grinding of such material as talc, barytes, limestone, filtering clay and similar materials.

The plant has a spur track from Southern Pacific Railroad into the yard. From the car the material goes to an unloading platform, to a No. 3 gyratory crusher, then to conveyor belt, to a 3-roll Raymond mill equipped with air system and dust collector. All material is sacked. Daily capacity is from 10 to 15 tons.

SOUTHERN CALIFORNIAN PLANTS

By W. Burling Tucker, Mining Engineer

California Talc, Incorporated (formerly *Mineral Products Co.*), 837 Jackson street, Los Angeles. Officers of the company are George L. Ratcliffe, president and general manager; H. C. Evans, vice president, and R. E. Scott, Jr., secretary and treasurer.

This company manufactures and sells, under the trade name of 'Aquagel,' a conditioning compound for oil-well rotary mud, also an

admixture for concrete. The oil-well mud is made from a bentonite which is shipped from Sodaville and Beatty, Nevada, while the concrete admixture is prepared by the use of a bentonite from Osage, Wyoming.

The raw material is delivered to the plant in railroad cars. From the car it goes to an elevator, Acme jaw crusher and crushed-ore bin. From the bin, reciprocating feeders deliver it to two Bethlehem pulverizers, thence by air separation to cyclone dust collector, bag house and finished product bins; from the finished product bin, by gravity, to a Howe packer. The product is 75% 200-mesh. Capacity of plant is 75 tons per day.

The company also has a custom crushing plant equipped as follows: Acme jaw crusher to elevator, through a 5′ x 16′ trommel, oversize to Symons disc crusher, thence back to the elevator. Undersize goes from trommel to Cottrell two-deck screen; oversize to Denver 14″ x 30″ rolls; middling from screen to finished product bin; screenings from second screen goes to waste. Discharge from 14″ x 30″ rolls goes to elevator and two-deck Overstrom vibrating screen; oversize to 12″ x 24″ rolls back to elevator; middling from screens to finished product bin; screenings from second screen to waste. Finished product bin has a capacity of 50 tons. Plant is equipped with dust collectors throughout.

Chamberlain Company, 2550 East Ninth street, Los Angeles. Lee Chamberlain, president; J. C. Tidball, vice president; Roy S. Kellogg, secretary; A. W. McAllister, treasurer.

This company does a general grinding business. They own no deposits.

Their plant contains the following equipment: 36″ jaw crusher, Symons disc crusher, rolls, screens, one 3-roller and one 5-roller Raymond mill, 2 Hardinge ball mills; products sacked by Bates packers.

No further information available.

Bibl: Pit and Quarry, Sept. 25, 1929, vol. XVIII, No. 13, p. 69.

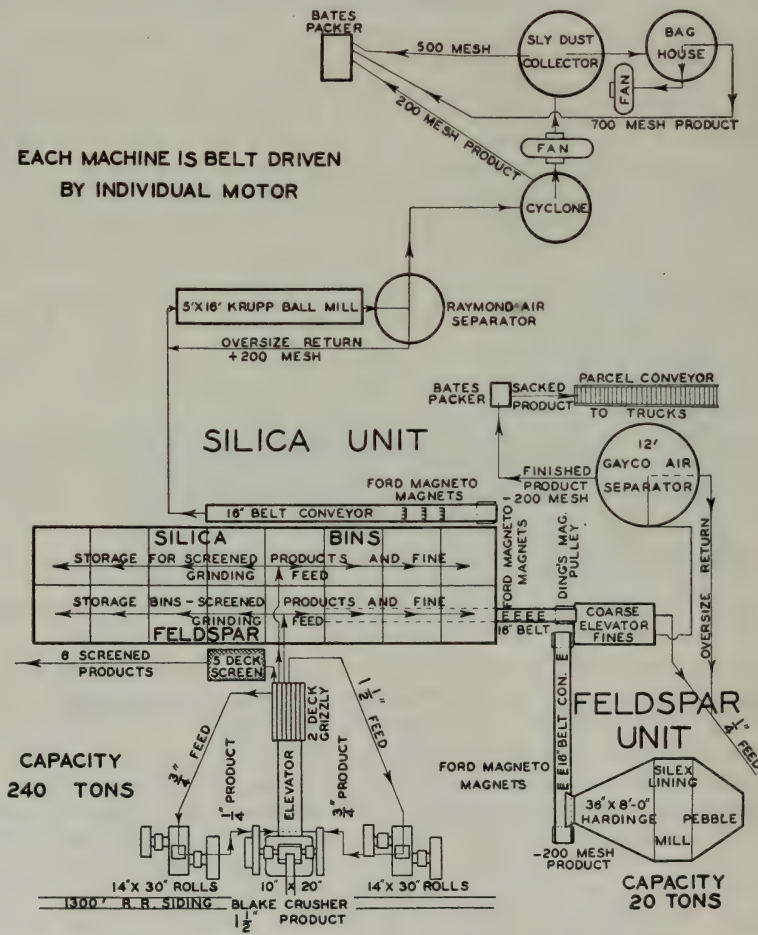
Flynt Silica and Spar Company, 1081 Richmond street, Los Angeles. A. F. Flynt, president; E. F. Spencer, secretary and treasurer.

This company does a general custom grinding business, as well as producing raw materials and preparing the following products: Silica, feldspar, kaolin, pumice, mica, bentonite and barite. The largest part of their output is consumed by the ceramic trade.

The kaolin comes from deposits in Nevada, the feldspar from the company's deposit near Jacumba Hot Springs, San Diego County, and from Kingman, Arizona. The silica practically all comes from a San Diego County deposit. Mica is shipped in from New Mexico at present but the company is opening a deposit in Yuma County, Arizona. Bentonite comes from near Barstow, San Bernardino County.

The mica is consumed principally by the rubber trade, some going to paper manufacturers. The rubber industry demands that it be ground 99 per cent to 100-mesh, the paper requirements being 95 per cent, 200-mesh. The bentonite is used for oil-well mud, by the building, soap and paint trades and seems to have great possibilities in the reclaiming of newspapers. All of the bentonite is ground to minus 200-mesh.

FLOW SHEET
MAIN GRINDING PLANT
FLYNT SILICA & SPAR CO.
1081 RICHMOND ST. LOS ANGELES, CALIF.



NOTE:- THIS PLANT ALSO CONTAINS FOUR OTHER UNITS FOR GRINDING MICA, DARK MINERALS, IRON ORE AND ROCK DUST. THESE ARE NOT SHOWN ON THE FLOW SHEET BUT ARE DESCRIBED IN THE TEXT.

Their plant consists of six units, diagrammatic flow sheet of the two principal units, namely, feldspar and silica, being printed herewith. The other units are: Mica, dark minerals, iron ore and rock dust.

Feldspar Unit.

Material delivered in railroad cars on a spur which is 1300′ long, unloaded by hand to a 10″ x 20″ Blake-type crusher. Product, 1½″, goes to elevator, 8″ x 12″ buckets, onto a double-deck grizzly; oversize from first grizzly by gravity to 14″ x 30″ Denver rolls; ¾″ product by belt conveyor to boot of the elevator; oversize from second grizzly, by gravity to 14″ x 30″ Denver rolls; ¼″ product by belt conveyor to boot of the elevator; undersize from second grizzly to 5 storage bins, 50 tons capacity each, or to a 5-deck screen.

Feldspar Fine Grinding.

Product goes from bins by 16″ conveyor belt, equipped with a series of Ford-magneto magnets and Ding's magnetic pulley for removing iron, to bucket elevator, to bin; from this bin, by gravity to silex-lined 36″ x 8′-0″ Hardinge pebble mill; discharged onto belt conveyor which delivers to same elevator mentioned above. The buckets on this elevator have partitions in them, one side carrying the pebble mill feed, the other, the mill product. The fines are discharged to a 12′ Gayco air separator, the oversize returning to the pebble mill by gravity. The finished product, which is 200-mesh and finer, goes to a Bates packer where it is sacked and then conveyed to trucks in the street by a parcel conveyor.

Silica Fine Grinding.

The same coarse-crushing equipment is used for the silica as for the feldspar. From the silica bins the material is delivered to a 5′ x 16′ Krupp ball mill, by a 16″ conveyor equipped with magnets for the removal of iron. Discharge from ball mill to Raymond air separator and cyclone dust collector, connected to a fan which draws its air through the feed end of the ball mill. Material settling out of the air separator returns to the ball mill. That drawn over goes to the cyclone, where a 200-mesh product is settled out. Another fan operating through a Sly dust collector and bag house, draws the fines from the cyclone. A 500-mesh product settles out of the Sly collector and 700-mesh material is recovered in the bag house. Each product goes to a Bates packer where it is sacked.

Rock Dust Plant.

The 1½″ feed goes to a Sturtevant ring-roll pulverizer which reduces it to 200-mesh and has a capacity of 150 tons in 24 hours; discharge to elevator and Sturtevant air separator which is in closed circuit with the pulverizer.

Mica Unit.

Material is fed to a Williams hammer mill, thence to two revolving wooden drums, about 10′ diameter by 5′ face. The grinding is done by cylindrical pieces of hardwood, 4″ diameter by from 8″ to 12″ long. A charge is ground (wet) for 24 hours, then discharged to settling tanks, thence through a duplex plunger pump to 24-leaf filter

press and gas-tray drier, elevator to shaking screen. Oversize is returned to wooden drums; screenings to flour-mill reel with 100-mesh screen; oversize to wooden drums; screenings by screw conveyor to second flour-mill reel, with 200-mesh screen. The two products here made are sacked for the rubber and paper trades.

Dark Mineral Unit.

Equipment consists of American pulverizer hammer mill; elevator; 4-deck shaking screen; oversize to 14″ x 30″ Denver rolls; discharge to elevator; screened product to storage bins.

Iron Ore Crushing Plant.

The material goes from elevator to bin; by gravity to Fuller-Lehigh 45″ pulverizer; by elevator to air separator which is in closed circuit with the pulverizer. Product 100- to 400-mesh goes to a Howe packer.

There is, in the yard, a rotary calcining tube which is also used as a drier.

Thirty men are employed at the plant.

Hill Bros. Chemical Company, 2159 Bay street, Los Angeles. C. B. Hill, M. C. Hill and C. W. Hill.

This concern does a general grinding business, handling nonabrasive, nonmetallic materials. The principal products are crystalline limestone, dolomite, talc, pumicite and barite.

They have deposits of bentonite at Barstow, clay at Muroc, pumicite and barite near Daggett, limestone at Victorville, talc at Silver Lake and diatomaceous earth near Randsburg.

The equipment of the crushing and grinding plant is as follows: Material delivered in railroad cars. Four-car spur track; No. 2½ Wheeling jaw crusher; to elevator; to Grundler grinder and Cottrell 4-deck screen. Products are 4, 10, 16, 32 and 40-mesh. Dust collectors are used on all machines.

The plant is so arranged that the material from the elevator mentioned above may be sent to a Raymond mill, elevator, air separator and bag house. The material is sacked by hand. Products are 200-mesh and finer.

There is also a 4′ silex-lined tube mill, 2 dry mixers, gas and steam driers.

Capacity of the plant is 40 to 50 tons daily.

Los Angeles Chemical Company, 1960 Santa Fe avenue, Los Angeles. A. P. Hall, president; J. J. Harper, vice president; H. N. Carey, secretary.

This company, in their plant at South Gate, grind barite from Laws and Barstow, feldspar from Inyokern, fluorspar from Wickenburg, Arizona, Italian pumice, graphite from Sonora, Mexico, Venetian red (brick dust and hematite) and manganese dioxide from the Maria Mountains, Riverside County.

The flow sheet of the plant is as follows: No. 2½ Wheeling jaw crusher to elevator; to 14″ x 30″ Denver roughing rolls; Cottrell vibrating screen; oversize to 14″ x 30″ Denver rolls; elevator back to screen; by belt conveyor to rotary drier; thence by elevator to bin. From the bin by reciprocating feeder to 5′ x 10′ tube mill, in closed

circuit, with 8′ Emerick air separator, which turns out a 200-mesh product.

There is also a Williams hammer mill and 00 Raymond mill, in closed circuit with a Raymond air separator, cyclone and bag house for finer grinding.

Pacific Coast Talc Company, 2149 Bay street, Los Angeles. W. S. Lockhart, president; A. M. Algeo, secretary; George Ames, general manager.

This company prepares and markets the following materials: Talc, lime-rock, clays, barite and other nonabrasive, nonmetallic minerals.

They are mining talc at Silver Lake and limestone near Victorville; also have a clay deposit in Boquet Canyon.

Crushing and grinding plant contain the following equipment: Sixteen-inch belt conveyor delivers material from railroad car to ¾″ grizzly; to No. 2½ Wheeling jaw crusher; to bucket elevator; to storage bin. From the bin it is fed by a reciprocating feeder to a Raymond mill; by air separation to cyclone and bag house to finished product bins; thence by gravity to a Howe screw packer where it is sacked in 100, 125 and 200-lb. bags. The plant also contains a gas-heat tray drier.

Capacity of grinding equipment is 40 tons daily. The crushing plant will handle 125 tons per day.

Victorville Lime Rock Company, 2149 Bay street, Los Angeles. George Ames, president; Frank R. Wicks, general manager.

This company's quarry and crushing plant is at Victorville. They handle crude, white lime rock and crushed rock for the glass and fertilizer trade.

The Victorville crushing plant consists of Williams crusher and pulverizer. The capacity is approximately 10 tons per hour.

Western Talc Company, 1901 East Slauson avenue, Los Angeles. F. H. Savell, president and manager; M. E. Williams, secretary.

This company does a general grinding business of nonabrasive, nonmetallic minerals.

The company owns and operates a deposit of talc in Death Valley. This material is loaded into cars at Acme Station. Bentonite is shipped to the plant from Beatty, Nevada, silica from near Daggett, clays come from various producers.

Materials are delivered to the plant in trucks or railroad cars. Their spur track has space for five cars. From the car it goes to a No. 2½ Wheeling jaw crusher; elevator to two feed bins; reciprocating feeder to high-side Raymond mill; by air separation to cyclone; bag house and two finished-product bins; thence to two Howe heavy-duty packers.

This equipment is designed for products from 200 to 600-mesh.

Crushing Screening Plant.

From the Wheeling crusher the material goes by elevator to a shaking screen; oversize by gravity to Williams hammer mill; elevated to another set of screens; oversize returned to mill. Screenings from either set of screens may go to either the coarse finished-product bins or the Raymond mill feed. There are four coarse finished-product bins. Four, 6, 10, 16, 32 and 40-mesh are the usual products.

ADMINISTRATIVE

WALTER W. BRADLEY, State Mineralogist

Personnel.

There have been no changes nor additions of personnel to be noted during the past three months.

New Publications.

Mining in California (quarterly), January, 1930, being Chapter 1 of State Mineralogist's Report XXVI. Price 25 cents. The January issue contains a report on the Mineral Resources of Santa Clara County; also special articles on: 'Barite in California'; 'Mercury Deposits in Coso Range, Inyo County'; 'Aerial Photography and its Importance to California Geologists.'

Summary of Operations, California Oil Fields, Vol. 14, No. 12, June, 1929 (Division of Oil and Gas), containing also, special article on 'Crooked Holes.'

Commercial Mineral Notes, Nos. 85, 86, 87, April, May, June, 1930, respectively. These 'notes' contain the lists of 'mineral deposits wanted' and 'minerals for sale' issued in the form of a mimeographed sheet, monthly. It is mailed free to those on the mailing list for MINING IN CALIFORNIA.

Mails and Files.

The Division of Mines maintains, in addition to its correspondence files and the library, a mine file which includes original reports on the various mines and mineral properties of all kinds in California.

During each quarterly period there are several thousand letters received and answered at the San Francisco office alone, covering almost every phase of prospecting, mining and developing mineral deposits, reduction problems, marketing of refined products, and mining law. In addition to this, hundreds of oral questions are answered daily, both at the main office and the district offices, for the many inquirers who come in for personal interviews and to consult the files and library.

MINERALS AND STATISTICS

Statistics, Museum, Laboratory

HENRY H. SYMONS, Statistician and Curator

STATISTICS

Data on the 1929 production of several California minerals were given in the April issue of MINING IN CALIFORNIA, and some additional ones are presented herein. Copy of the complete annual report for the year is now being prepared and will shortly go to the printer as Bulletin No. 103 of the Division of Mines.

COPPER

Copper is second only to gold among the metals mined in California. The output for 1929 amounted to a total of 33,809,258 pounds recoverable metal valued at $5,941,799. This was an increase in both amount and value over the 1928 figures, which were 25,162,304 pounds and $3,623,360. The 1929 figures include also a small production over the past four years coming from Alameda County, for which reports had not been previously received. The average price of copper for 1929 was 17.6 cents per pound compared with 14.4 cents a pound in 1928.

Plumas County, as it has for several years past, ranked first in the production of copper for 1929, with an output of 25,253,603 pounds. Shasta County came second with 6,066,098 pounds and Calaveras County third with 1,200,494 pounds.

Distribution of the 1929 copper output in California by counties is as follows:

County	*Pounds*	*Value*
Alameda	321,844	$48,016
Alpine	7,260	1,278
Calaveras	1,200,494	211,287
Del Norte	5,002	880
Humboldt	64,553	11,361
Inyo	17,733	3,121
Los Angeles	1,981	349
Madera	19,254	3,389
Mariposa	6,302	1,109
Mono	16,552	2,913
Napa	4,356	767
Nevada	5,702	1,004
Plumas	25,253,603	4,444,634
Riverside	1,471	259
San Bernardino	81,846	14,405
Shasta	6,066,098	1,067,633
Siskiyou	34,704	6,108
Trinity	615,579	108,342
Tuolumne	82,383	14,499
Amador, El Dorado, Fresno, Orange*	2,541	445
Totals	33,809,258	$5,941,799

* Combined to conceal the output of a single operator in each.

LEAD

The production of lead in California in 1929 was 1,428,777 pounds of recoverable metal valued at $90,014, as compared with the 1928 figures which were 1,882,795 pounds valued at $109,102. The average value of lead in 1929 was 6.3 cents per pound; in 1928 5.8 cents per pound and in 1927 6.3 cents per pound.

As in the past the principal output of lead was from the lead silver ores of Inyo County.

Distribution of the 1929 lead output by counties was as follows:

County	*Pounds*	*Value*
Calaveras	8,277	$521
Inyo	1,335,831	84,157
Mono	19,602	1,235
Nevada	1,603	416
Orange	1,471	93
San Bernardino	53,532	3,373
Amador, Napa, Plumas, Sacramento, Siskiyou, Tuolumne*	3,461	219
Totals	1,428,777	$90,014

* Combined to conceal the output of a single operator in each.

PLATINUM

The production of platinum metals in California in 1929 totaled 246 ounces crude, containing 212 fine ounces valued at $14,416, compared with 312 fine ounces valued at $27,902 in 1928. All but about one ounce of this amount came from the gold dredges. The metal was mined by a single producer in each of the following counties: Sacramento, Shasta, Stanislaus and Yuba. Yuba had the largest production. In addition to the above there was some platinum metal recovered but not sold in Butte County.

Of the above, 212 fine ounces were platinum, 28 fine ounces were iridium, 27 fine ounces were osmium and 8 fine ounces were palladium and ruthenium.

TUNGSTEN

The commercial production of tungsten ores and concentrates in California began in 1905 and has been continuous since, with the exception of 1920–1922, inclusive, when the mines were shut down owing to low prices due to excess stocks following the war and to lack of tariff protection against foreign importations. Production was resumed on a small scale late in 1923, and is now at practically its prewar average annual tonnage, although the 1929 figures are less than those for 1928.

The material shipped in 1929 included both high-grade sorted ore and concentrates, coming from properties in Inyo, Kern and San Bernardino counties. A total of 142 tons were reported produced, yielding 150 tons recalculated to 60% WO_3, valued at a total of $106,280.

MUSEUM

The Museum of the State Division of Mines possesses an exceptionally fine collection of rocks and minerals of both economic and academic value. It ranks among the first five of such collections in North America and contains not only specimens of most of the known minerals found in California, but much valuable and interesting material from other states and foreign countries as well.

In December of 1929 George E. Farish, Mrs. A. H. Collburn and Mrs. John S. Collburn presented their father's (the late John B. Farish, San Francisco mining engineer) mineral collection to the State Division of Mines. This collection consists of some 800 choice minerals from all over the world, some of which are extremely rare. Three exhibit cases have been allotted to the general collection, while the gold specimens will occupy a shelf in one of the gold safes.

Mr. Farish was a mining engineer of world-wide fame and did work on all the continents, which enabled him to obtain the best of minerals from many places, as his collection shows.

Mineral specimens suitable for exhibit purposes are solicited, and their donation will be appreciated by the State Division of Mines as well as by those who utilize facilities of the collection.

The exhibit is daily visited by engineers, students, business men, and prospectors, as well as tourists and mere sightseers. Beside its practical use in the economic development of California's mineral resources, the collection is a most valuable educational asset to the state and to San Francisco.

LABORATORY

FRANK SANBORN, Mineral Technologist

Many thousand prospectors and others have taken advantage of the assistance which is offered by the Laboratory of the Division of Mines, and a steady increase in the number of samples received by this department is evident. Samples should be limited to no more than three at one time and those submitting material are urged to ask specific questions, especially when a certain mineral is thought to be present. Assays and quantitative analyses are not made for the public, but an attempt is made to give sufficient information for the sender to decide if further analytical work is warranted. In addition to the identification of minerals, assistance is given in finding a market for those having commercial possibilities.

LIBRARY

HERBERT A. FRANKE, Librarian

In addition to the numerous standard works, authoritative information on many phases of the mining and mineral industry is constantly being issued in the form of reports and bulletins by various government agencies.

The library of the Division of Mines contains some five thousand selected volumes on mines, mining and allied subjects, and it is also a repository for reports and bulletins of the technical departments of federal and state governments and of educational institutions, both domestic and foreign.

It is not the dearth of the latter publications, but rather a lack of knowledge of just what has been published and where the reports may be consulted or obtained, that embarrasses the ordinary person seeking specific information.

To assist in making the public acquainted with this valuable source of current technical information, MINING IN CALIFORNIA contains under this heading a list of all books and official reports and bulletins received, with names of publishers or issuing departments.

Files of all the leading technical journals will be found in the library, and county and state maps, topographical sheets and geological folios. Current copies of local newspapers published in the mining centers of the state are available for reference.

The library and reading room are open to the public during the usual office hours, when the librarian may be freely called upon for all necessary assistance.

OFFICIAL PUBLICATIONS RECEIVED

Governmental.

U. S. Geological Survey:

Professional Papers:

155 The Flora of the Denver and Associated Formations of Colorado. By F. H. Knowlton.
156 Revision of the Lower Eocene Wilcox Flora of the Southeastern States.

Bulletins:

811 Contributions to Economic Geology, 1929.
813-B The Chakachamna—Stony Region, Alaska. By S. R. Capps.

Water-Supply Papers:

615 Surface Water Supply of Hawaii.
616 Geology and Water Resources of the Kau District, Hawaii.
618 The Green River and Its Utilization. By R. R. Woolley.
621 North Atlantic Slope Drainage Basins.
629 Colorado River Basin.

U. S. Bureau of Mines:

Technical Papers:

469 The Wire Saw in Slate Quarrying. By O. Bowles.
472 Acceleration of Extraction of Soluble Copper from Leached Ores. By M. Guggenheim and J. D. Sullivan.

Bulletins:

318 Petroleum Refinery Statistics, 1928.

Mineral Resources of the United States:

Asphalt and Related Bitumens in 1928. By A. H. Redfield.
Bauxite and Aluminum in 1928.
Cement in 1928. By B. W. Bagley.
Coal in 1928.
Gold, Silver, Copper, Lead and Zinc in Utah in 1928. By C. N. Gerry.
Gold, Silver, Copper and Lead in South Dakota and Wyoming in 1928. By C. W. Henderson.
Gold, Silver, Copper, Lead and Zinc in Nevada in 1928. By V. C. Heikes.
Mica in 1928. By B. H. Stoddard.

Economic Papers:

No. 9—Petroleum Coke. By E. B. Swanson.

Petroleum Field Office:

Recent Articles on Petroleum and Allied Substances:

March, 1930.
April, 1930.

Reports of Investigations:

2993—Some Phases of the Relative Responsibility of Management and Workers for Accidents in Mines. By D. Harrington.
2994—Effect of Sealing on Acidity of Mine Drainage. By D. R. Leitch, W. P. Yant, and R. R. Sayers.
2996—Apparatus for Vacuum Distillation of Lubricating and Heavy Petroleum Oils. By Martin J. Gavin and Arch L. Foster.
(A revision of R. I. 2819, issued in 1927.)
2997—Engineering Study of the Seminole Area, Seminole and Pottawatomie Counties, Oklahoma. By R. R. Brandenthaler, W. S. Morris, and C. R. Bopp.
2998—Retreatment of Mother Lode Carbonaceous Slime Tails. By E. S. Leaver and J. A. Woolf.
(Presents summary of data to be printed in full later. Describes flotation methods and roasting and cyanidation of concentrates.)
3000—Official Changes in the Active List of Permissible Explosives and Blasting Devices for April, 1930.
3001—Nine Years of Smoke-abatement Work at Salt Lake City. By Austin Gudmundsen.
3009—The Sand and Gravel Safety Contest of 1929. By W. W. Adams.
3013—Toxicity of Dichloro-Difluoro Methane: A New Refrigerant. By R. R. Sayers, W. P. Yant, John Chornuak, and H. W. Shoaf.
3019—The National Safety Competition of 1929. By W. W. Adams.
(Presents the general results of the contest. Gives tables showing the general scope of the competition, scale o ftime losses for weighing deaths and permanent injuries so as to show severity of accidents, and accident rates for mines and quarries in the National Safety Competition for the years from 1925 to 1929.)
3020—Influence of Washing Coal on Coke Properties, and on Gas and By-Product Yields. By A. C. Fieldner.
(Tells what results may be expected from use of washed coal in a carbonizing plant.)

Information Circulars:

6252—Mining Laws of Chile. By A. D. Garman.
6257—The Work of the United States Bureau of Mines.
6258—Safety Ahievements of a Pennsylvania Bituminous Coal Mine and of a Coal-mine Superintendent. By Francis Feehan.
6259—Mining Laws of Panama. By A. D. Garman.
6263—Performance Tests for Trailing Cables. By L. C. Ilsley.
6264—Electrical Blasting Practice at Some Coal Mines in the State of Washington. By S. H. Ash.
6265—Mining Laws of Esthonia. By E. P. Youngman.
6266—Mining Laws of French Morocco. By E. P. Youngman.
6267—Points to be Considered in the Design of Covers for Explosion-proof Compartments. By L. C. Ilsley.

6268—The Granite Industry—Dimension Stone. By Oliver Bowles.
(Gives important data on occurrence, uses, quarrying, imports, production, and prices.)
6269—Suggested Safety Rules for Installing and Using Electrical Equipment in Coal Mines. By L. C. Ilsley and Charles M. Means.
6270—Mining Laws of the Belgian Congo. By E. P. Youngman.
6271—Mining Laws of Germany (Prussia). By E. P. Youngman.
6272—Mining Laws of Ecuador. By A. D. Garman.
6274—Selected Bibliography and Map of Manganese Deposits of the United States by Districts. By M. V. Healey and A. L. Johns.
6275—Mine Safety and Accident Economy. By E. H. Denny.
6278—Mining Laws of Belgium. By E. P. Youngman.
6287—Geophysical Abstracts No. 12. By F. W. Lee.
6289—Mining Methods of the Campbell Mine of the Calumet and Arizona Mining Co., Warren, Ariz. Inclined Cut and Fill, and Semishrinkage. By H. M. Lavender.
6292—Petroleum Refineries in the United States, January 1, 1930. By G. R. Hopkins and E. W. Cochrane.
6309—Geophysical Abstract No. 13. By F. W. Lee.

U. S. Bureau of Foreign and Domestic Commerce:

Monthly Summary of Foreign Commerce of the U. S.
Part 1, March, 1930.
Part 2, March, 1930.

California State Park Commission:

Report of State Park Survey.

California State Library:

Vol. 24, Nos. 1–4.
Vol. 25, No. 2.

Florida State Geological Survey:

Bulletin No. 3—Miocene Gastropods and Scaphopods of the Choctawatchee Formation of Florida. By W. C. Mansfield.
Bulletin No. 4—The Foraminifera of the Choctawhatchee Formation of Florida. By J. A. Cushman.

Idaho Bureau of Mines:

31st Annual Report of the Mining Industry of Idaho for the Year 1929. By S. Campbell.

Illinois Geological Survey:

R. I. No. 19—I. Physiographic Divisions of the Area Covered by the Illinoian Drift-sheet in Southern Illinois.
II. Recent Discoveries of Pre-Illinoian Drift in Southern Illinois. By P. MacClintock.
R. I. No. 20—Weathered Zones of the Drift-sheets of Illinois. By M. M. Leighton and P. MacClintock.
Bulletin No. 57—Geology and Mineral Resources of the Alexis Quadrangle. By H. R. Wanless.

Pennsylvania Geological Survey:

Bulletin M6—Bituminous Coal Fields of Pennsylvania. By G. H. Ashley.

Argentina Ministerio de Agricultura de la Nacion:

No. 80—Estadistica de Petroleo.

Canada Department of Mines:

No. 699—Abrasives. (Part IV.)
No. 2207—The Disappearance of the Huronian. By T. T. Quirke and W. H. Collins.
No. 2209—Lardean Map-area, British Columbia.
No. 2210—Fluorspar Deposits of Canada. By M. E. Wilson.
No. 2230—Peat Bogs in Southeastern Canada. By V. Aner.

Commission Geologique de Finlande:

No. 90—Geologie des Soanlahti-Gebietes.

New South Wales Department of Mines:
No. 35—The Yerranderie Silver Field. By T. F. Harper.

New Zealand Department of Scientific and Industrial Research:
62nd Annual Report of the Dominion Laboratory. By J. S. Maclaurin.

Ontario Department of Mines:
Vol. XXXVIII, Part 1, 1929.
Vol. XXXVIII, Part 3, 1929—Sudbury Basin Area. By A. G. Burrows and H. C. Rickaby.
Vol. XXXVIII, Part 6, 1929—Thirty-eighth Annual Report.
Vol. XXXVIII, Part 7, 1929.

Transvaal Chamber of Mines:
President's Address.

Western Australia Geological Survey:
Bulletin 94—Geology and Ore Deposits of the Boulder Belt, Kalgoorlie. By F. L. Stillwell.
Annual Progress Report, 1928.

Societies and Educational Institutions.

American Association of Petroleum Geologists:
Vol. 14, No. 5.
Vol. 14, No. 6.

American Bureau of Metal Statistics:
Tenth Annual Issue, 1929.

American Institute of Mining and Metallurgical Engineers:
Technical Publication No. 264—Quicksilver Industry in 1929.

American Petroleum Institute:
Reports of Tenth Annual Meeting.

Buffalo Society of Natural History:
Vol. XV, No. 11—Contributions to the Natural History of the Burbot. By M. P. Fish.

Bulgarian Geological Society:
Vol. II, Part 2, 1930.

Colorado College:
General Series No. 168.

Colorado School of Mines:
Geophysical News and Review of Geophysical Literature. By J. A. Malkorsky, C. A. Heiland, and Dart Wantland.
Vol. XXV, No. 2, Sup. A.

Canadian Institute of Mining and Metallurgy:
No. 217, May, 1930.
No. 218, June, 1930.

Economic Geology:
Vol. 25, No. 3, with supplement.
Vol. 25, No. 4.

Field Museum of Natural History:
Vol. I, No. 1—Studies of Fossil Mammals of South America.
Vol. VIII, No. 1—Annual Report, 1929.

Institute of Mining and Metallurgy, London:
No. 308, May, 1930.
Transactions, Vol. XXXVIII.

Institution of Petroleum Technologists:
The Action of Potassium Permanganate on Unsaturated Hydrocarbons.
The Chemical Examination of Gasolines and Light Mineral Oils.
Synthetic Fuels.

International Nickel Co.:
Nickel. By A. J. Wadhams.
The Nickel Industry. By P. D. Merica.
Nickel Alloy Steel Products.

John Crear Library:
35th Annual Report, 1929.

Library of Congress:
Vol. 21, No. 1.

Mineralogical Society of America:
Vol. 15, No. 5.
Vol. 15, No. 6.

Mining and Metallurgical Society of America:
Bulletin No. 210.

National Research Council:
Report of the Committee on Sedimentation, 1928-1929.

National Sand and Gravel Association, Inc.:
Bulletin 5—Effect of Characteristics of Coarse Aggregates on the Quality of Concrete. By S. Walker.
Circular 5—The Story of Glacial Sands and Gravels. By H. A. Whitnall.

Philippine Journal of Science:
Vol. 42, No. 1.
Vol. 42, No. 2.

Polskie Towarzystwo Przyradmikow im Kopernika:
Geologja, Mineralogja i Paleontologja, VII.

Real Academia de Ciencias y Artes, Barcelona, Spain:
Vol. XXI, Nos. 17 to 24, incl.

Seismological Society of America:
Vol. 13, No. 1—A Fault Map of California, with map.

Stanford University:
Department of Geology.
Vol. 1, No. 1—Shallow-water Foraminifera from the Channel Islands of Southern California. By J. A. Cushman and W. W. Valentine.

State College of Washington:
Vol. 12, No. 11—Electro-hydro-metallurgical Process for Copper Flotation Concentrate. By A. E. Drucker and C. F. Floe.

University of California:
Vol. 19, No. 2—The Jurassic Rocks of Ashcraft, British Columbia. By C. H. Crickmay.
Vol. 19, No. 3—Fossil Termite Pellets from the Seminole Pleistocene. By S. F. Light.
Vol. 19, No. 4—The Devonian of California. By C. R. Stauffer.
Vol. 19, No. 5—Notes on the Later Geologic History of Tahiti (Society Islands). By H. Williams.

Western Society of Engineers:
Vol. 35, No. 3.

Books.

The Engineering Index, 1929. By American Society of Mechanical Engineers.
Iron and Steel Technology in 1928. By A. I. M. E.
Annual Reports of the Alaska Juneau Gold Mining Co., Bunker Hill and Sullivan Mining and Concentrating Co., and Treadwell Yukon Co., Ltd.

John Hays Hammond Public Mining Library:
Principles of Iron Founding. By R. Moldenke.

Chemical Engineering Series: The Aluminum Industry. By Edwards, Frary, and Jeffries. 2 vols.

Maps.

U. S. Geological Survey Topographic:

California:

Inglewood Quadrangle, Los Angeles County.

Current Magazines on File.

For the convenience of persons wishing to consult the technical magazines in the reading room, a list of those on file is appended:

Architect and Engineer, San Francisco.
Asbestos, Philadelphia, Pennsylvania.
Asbestology, Canadian Asbestos Co., Montreal, Canada.
Bessemer Monthly, Grove City, Pennsylvania.
Brick and Clay Record, Chicago.
California Safety News, San Francisco.
Caterpillar, San Leandro, California.
Chemical and Metallurgical Engineering, New York City.
Chemical Engineering and Mining Review, Melbourne, Australia.
Commerce Reports, Washington, D. C.
Colorado School of Mines, Golden, Colorado.
Engineering and Mining Journal, New York City.
Explosive Service Bulletins, Washington, Delaware.
Fuel Oil, Chicago, Illinois.
Fusion Facts, Whittier, California.
Graphite, Jersey City.
Grizzly Bear, Los Angeles.
Hercules Mixer, Wilmington, Delaware.
Industrial Employment Information Bulletin, Washington, D. C.
Lubrication, The Texas Co., New York City.
Mining Congress Journal, Washington, D. C.
Mining and Industrial Record, Vancouver, B. C.
Mining Journal, London.
Mining Journal, Phoenix, Arizona.
Mining and Metallurgy, New York City.
Mining Review, Salt Lake City.
Mining Truth, Spokane, Washington.
Monthly Review of Business Conditions, San Francisco.
National Sand and Gravel, Washington, D. C.
Oil Bulletin, Los Angeles.
Oil Field Engineering, Philadelphia, Pennsylvania.
Oil and Gas Journal, Tulsa, Oklahoma.
Oil, Paint and Drug Reporter, New York City.
Oil Trade, New York City.
Oil Weekly, Houston, Texas.
Pit and Quarry, Chicago.
Pacific Purchaser, San Francisco.
Petroleum Times, London, E. C. 2.
Petroleum Age, Chicago.
Petroleum World and Oil Age, Los Angeles.
Queensland Government Mining Journal, Brisbane, Australia.
Record, Associated Oil Co., San Francisco.
Rocks and Minerals, Peekskill, New York.
Rock Products, Chicago.
Scientific American, New York City.
Southwest Builder and Contractor, Los Angeles.
Standard Oil Bulletin, San Francisco.
Stone, New York City.
Through the Ages, Baltimore.

Newspapers.

The following papers are received and kept on file in the library:

Amador Dispatch, Jackson, California.
Barstow Printer, Barstow, California.
Beaumont Gazette, Beaumont, California.
Bridgeport Chronicle-Union, Bridgeport, California.
California Oil World, Los Angeles, California.
Colusa Daily Sun, Colusa, California.
Daily Commercial News, San Francisco, California.
Daily Midway Driller, Taft, California.
Del Norte Triplicate, Crescent City, California.
Denver Mining Record, Denver, Colorado.
Exeter Sun, Exeter, California.
Goldfield News, Goldfield, Nevada.
Inyo Independent, Independence, California.
Inyo Register, Bishop, California.
Ione Valley Echo, Ione, California.
Kettleman Oil and Gas News, Kettleman City, California.
Las Vegas Age, Las Vegas, Nevada.
Livermore Herald, Livermore, California.
Mariposa Gazette, Mariposa, California.
Mercury Register, Oroville, California.
Mojave Miner, Kingman, Arizona.
Morning Union, Grass Valley, California.
Mountain Messenger, Downieville, California.
National Industrial Review, San Francisco, California.
Nevada City Nugget, Nevada City, California.
Nevada Mining Press, Reno, Nevada.
Oil Refinery News, Bayonne, New Jersey.
Petroleum Press, Taft, California.
Placer Herald, Auburn, California.
Plumas Independent, Quincy, California.
San Diego News, San Diego, California.
Shasta Courier, Redding, California.
Siskiyou News, Yreka, California.
Sotoyome Scimitar, Healdsburg, California.
Stockton Record, Stockton, California.
Tuolumne Prospector, Tuolumne, California.
Ventura County News, Ventura, California.
Waterford News, Waterford, California.
Weekly Trinity Journal, Weaverville, California.
Western Mineral Survey, Salt Lake City, Utah.
Western Sentinel, Etna Mills, California.

PRODUCERS AND CONSUMERS

The producer and consumer of mineral products are mutually dependent upon each other for their prosperity, and one of the most direct aids rendered by the Bureau to the mining industry in the past has been that of bringing producers and consumers into direct touch with each other.

This work has been carried on largely by correspondence, supplemented by personal consultation. Lists of buyers of all the commercial minerals produced in California have been made available to producers upon request, and likewise the owners of undeveloped deposits of various minerals, and producers of them, have been made known to those looking for raw mineral products.

When the publication of MINING IN CALIFORNIA was on a monthly basis, current inquiries from buyers and sellers were summarized and lists of mineral products or deposits 'wanted' or 'for sale' included in each issue.

It is important that inquiries of this nature reach the mining public as soon as possible and in order to avoid the delay incident to the present quarterly publication of MINING IN CALIFORNIA, these lists are now issued monthly in the form of a mimeographed sheet under the title of 'Commercial Mineral Notes,' and sent to those on the mailing list for MINING IN CALIFORNIA.

EMPLOYMENT SERVICE

Following the establishment of the Mining Division branch offices in 1919, a free technical employment service was offered as a mutual aid to mine operators and technical men for the general benefit of the mineral industry.

Briefly summarized, men desiring positions are registered, the cards containing an outline of the applicant's qualifications, position wanted, salary desired, etc., and as notices of 'positions open' are received, the names and addresses of all applicants deemed qualified are sent to the prospective employer for direct negotiations.

Telephone and telegraphic communications are also given immediate attention.

Technical men, or those qualified for supervisory positions, and vacancies of like nature only, are registered, as no attempt will be made to supply common mine and mill labor.

Registration cards for the use of both prospective employers and employees may be obtained upon request, and a cordial invitation is extended to the industry to make free use of the facilities afforded. Parties interested should communicate direct with our San Francisco office.

PUBLICATIONS OF THE DIVISION OF MINES

During the past forty-nine years, in carrying out the provisions of the organic act creating the former California State Mining Bureau, there have been published many reports, bulletins and maps which go to make up a library of detailed information on the mineral industry of the state, a large part of which could not be duplicated from any other source.

One feature that has added to the popularity of the publications is that many of them have been distributed without cost to the public, and even the more elaborate ones have been sold at a price which barely covers the cost of printing.

Owing to the fact that funds for the advancing of the work of this department have often been limited, many of the reports and bulletins mentioned were printed in limited editions which are now entirely exhausted.

Copies of such publications are available, however, in the office of the Division of Mines, in the Ferry Building, San Francisco; New Orpheum Building, Los Angeles; State Office Building, Sacramento; Redding; Santa Maria; Santa Paula; Coalinga; Taft; Bakersfield. They may also be found in many public, private and technical libraries in California and other states, and foreign countries.

A catalog of all publications from 1880 to 1917, giving a synopsis of their contents, is issued as Bulletin No. 77.

Publications in stock may be obtained by addressing any of the above offices and enclosing the requisite amount in the case of publications that have a list price. Only coin, stamps or money orders should be sent, and it will be appreciated if remittance is made in this manner rather than by personal check.

The prices noted include delivery charges to all parts of the United States. Money orders should be made payable to the Division of Mines.

NOTE.—The Division of Mines frequently receives requests for some of the early Reports and Bulletins now out of print, and it will be appreciated if parties having such publications and wishing to dispose of them will advise this office.

REPORTS

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**First Annual Report of the State Mineralogist, 1880, 43 pp. Henry G. Hanks	----
**Second Annual Report of the State Mineralogist, 1882, 514 pp., 4 illustrations, 1 map. Henry G. Hanks	----
**Third Annual Report of the State Mineralogist, 1883, 111 pp., 21 illustrations. Henry G. Hanks	----
**Fourth Annual Report of the State Mineralogist, 1884, 410 pp., 7 illustrations. Henry G. Hanks	----
**Fifth Annual Report of the State Mineralogist, 1885, 234 pp., 15 illustrations, 1 geological map. Henry G. Hanks	----
**Sixth Annual Report of the State Mineralogist, Part I, 1886, 145 pp., 3 illustrations, 1 map. Henry G. Hanks	----
**Part II, 1887, 222 pp., 36 illustrations. William Irelan, Jr.	----
**Seventh Annual Report of the State Mineralogist, 1887, 315 pp. William Irelan, Jr.	----
**Eighth Annual Report of the State Mineralogist, 1888, 948 pp., 122 illustrations. William Irelan, Jr.	----
**Ninth Annual Report of the State Mineralogist, 1889, 352 pp., 57 illustrations, 2 maps. William Irelan, Jr.	----

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**Tenth Annual Report of the State Mineralogist, 1890, 983 pp., 179 illustrations, 10 maps. William Irelan, Jr.	----
Eleventh Report (First Biennial) of the State Mineralogist, for the two years ending September 15, 1892, 612 pp., 73 illustrations, 4 maps. William Irelan, Jr.	$1.00
**Twelfth Report (Second Biennial) of the State Mineralogist, for the two years ending September 15, 1894, 541 pp., 101 illustrations, 5 maps. J. J. Crawford	----
**Thirteenth Report (Third Biennial) of the State Mineralogist, for the two years ending September 15, 1896, 726 pp., 93 illustrations, 1 map. J. J. Crawford	----
Chapters of the State Mineralogist's Report, Biennial Period, 1913–1914, Fletcher Hamilton:	
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Mines and Mineral Resources, Colusa, Glenn, Lake, Marin, Napa, Solano, Sonoma and Yolo Counties, 208 pp., paper	.50
**Mines and Mineral Resources, Del Norte, Humboldt and Mendocino Counties, 59 pp., paper	----
**Mines and Mineral Resources, Fresno, Kern, Kings, Madera, Mariposa, Merced, San Joaquin and Stanislaus Counties, 220 pages, paper	----
**Mines and Mineral Resources of Imperial and San Diego Counties, 113 pp., paper	----
**Mines and Mineral Resources, Shasta, Siskiyou and Trinity Counties, 180 pp., paper	----
**Fourteenth Report of the State Mineralogist, for the Biennial Period 1913–1914, Fletcher Hamilton, 1915:	
A General Report on the Mines and Mineral Resources of Amador, Calaveras, Tuolumne, Colusa, Glenn, Lake, Marin, Napa, Solano, Sonoma, Yolo, Del Norte, Humboldt, Mendocino, Fresno, Kern, Kings, Madera, Mariposa, Merced, San Joaquin, Stanislaus, San Diego, Imperial, Shasta, Siskiyou and Trinity Counties, 974 pp., 275 illustrations, cloth	----
Chapters of the State Mineralogist's Report, Biennial Period, 1915–1916. Fletcher Hamilton:	
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Mines and Mineral Resources, Butte, Lassen, Modoc, Sutter and Tehama Counties, 91 pp., paper	.50
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**Mines and Mineral Resources, Los Angeles, Orange and Riverside Counties, 136 pp., paper	----
**Mines and Mineral Resources, San Bernardino and Tulare Counties, 186 pp., paper	----
**Fifteenth Report of the State Mineralogist, for the Biennial Period 1915–1916, Fletcher Hamilton, 1917:	
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Chapters of the State Mineralogist's Report, Biennial Period 1917–1918, Fletcher Hamilton:	
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Seventeenth Report of the State Mineralogist, 1920, 'Mining in California during 1920,' Fletcher Hamilton; 562 pp., 71 illustrations, cloth	1.75
Eighteenth Report of the State Mineralogist, 1922, 'Mining in California,' Fletcher Hamilton. Chapters published monthly beginning with January, 1922:	
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Chapters of Nineteenth Report of the State Mineralogist, 'Mining in California,' Fletcher Hamilton and Lloyd L. Root. January, February, March, September, 1923	Free
Chapters of Twentieth Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly. January, April, **July, October, 1924, per copy	$0.25
Chapters of Twenty-first Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly:	
January, 1925, Mines and Mineral Resources of Sacramento, Monterey and Orange Counties	.25
April, 1925, Mines and Mineral Resources of Calaveras, Merced, San Joaquin, Stanislaus and Ventura Counties	.25
July, 1925, Mines and Mineral Resources of Del Norte, Humboldt and San Diego Counties	.25
October, 1925, Mines and Mineral Resources of Siskiyou, San Luis Obispo and Santa Barbara Counties. Subscription, $1.00 in advance (by calendar year, only).	.25
Chapters of Twenty-second Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly:	
January, 1926, Mines and Mineral Resources of Trinity and Santa Cruz Counties	.25
April, 1926, Mines and Mineral Resources of Shasta, San Benito and Imperial Counties	.25
July, 1926, Mines and Mineral Resources of Marin and Sonoma Counties	.25
October, 1926, Mines and Mineral Resources of El Dorado and Inyo Counties, also report on Minaret District, Madera County	.25
Chapters of Twenty-third Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly:	
January, 1927, Mines and Mineral Resources of Contra Costa County; Santa Catalina Island	.25
April, 1927, Mines and Mineral Resources of Amador and Solano Counties	.25
July, 1927, Mines and Mineral Resources of Placer and Los Angeles Counties	.25
October, 1927, Mines and Mineral Resources of Mono County	.25
Chapters of Twenty-fourth Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly:	
January, 1928, Mines and Mineral Resources of Tuolumne County	.25
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**July 1928, Mines and Mineral Resources of Butte and Tehama Counties	----
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Chapters of Twenty-fifth Report of the State Mineralogist, 'Mining in California,' Walter W. Bradley. Published quarterly:	
January, 1929, Mines and Mineral Resources of Lassen, Modoc and Kern Counties; also on Special Placer Machines	.25
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**Bulletin No. 4. Catalogue of Californian Fossils, by J. G. Cooper, 1894, 73 pp., 67 illustrations. (Part I was published in the Seventh Annual Report of the State Mineralogist, 1887.) ----

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**Bulletin No. 9. Mine Drainage, Pumps, etc., by Hans C. Behr. 1896, 210 pp., 206 illustrations ----

**Bulletin No. 10. A bibliography Relating to the Geology, Palæontology and Mineral Resources of California, by Anthony W. Vogdes. 1896, 121 pp. ----

**Bulletin No. 11. Oil and Gas Yielding Formations of Los Angeles, Ventura and Santa Barbara Counties, by W. L. Watts. 1897, 94 pp., 6 maps, 31 illustrations ----

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**Bulletin No. 18. Mother Lode Region of California, by W. H. Storms. 1900, 154 pp., 49 illustrations ----

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**Bulletin No. 32. Production and Use of Petroleum in California, by Paul W. Prutzman. 1904, 230 pp., 116 illustrations, 14 maps	----
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**Bulletin No. 41. Mines and Minerals of California for 1904, by Charles G. Yale. 1905, 54 pp., 20 county maps	----
**Bulletin No. 42. Mineral Production of California, by Counties, 1905, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 43. Mineral Production of California for Nineteen Years, by Charles G. Yale. Tabulated sheet	----
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**Bulletin No. 49. Mines and Minerals of California for 1906, by Charles G. Yale. 34 pp.	----
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**Bulletin No. 63. Petroleum in Southern California, by P. W. Prutzman. 1912, 430 pp., 41 illustrations, 6 maps	----
**Bulletin No. 64. Mineral Production for 1911, by E. S. Boalich. 49 pp.	----
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**Bulletin No. 68. Mineral Production for 1913, with County Maps and Mining Laws, by E. S. Boalich. 160 pp.	----
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**Bulletin No. 71. Mineral Production for 1915, with County Maps and Mining Laws, by Walter W. Bradley. 193 pp., 4 illustrations	----
**Bulletin No. 72. The Geologic Formations of California, by James Perrin Smith. 1916, 47 pp.	----
**Reconnaissance Geologic Map (of which Bulletin 72 is explanatory), in 23 colors. Scale: 1 inch = 12 miles. Mounted	----
**Bulletin No. 73. First Annual Report of the State Oil and Gas Supervisor of California, for the Fiscal Year 1915–16, by R. P. McLaughlin. 278 pp., 26 illustrations	----
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Bulletin No. 77. Catalogue of Publications of California State Mining Bureau, 1880–1917, by E. S. Boalich. 44 pp., paper	Free
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**Bulletin No. 82. Second Annual Report of the State Oil and Gas Supervisor, for the Fiscal Year 1916–1917, by R. P. McLaughlin. 1918, 412 pp., 31 illustrations, cloth	----

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Bulletin No. 102. California Mineral Production for 1928, by Henry H. Symons. 1929, 210 pp., paper	Free

PRELIMINARY REPORTS

**Preliminary Report No. 1. Notes on Damage by Water in California Oil Fields, December, 1913. By R. P. McLaughlin. 4 pp.	----
**Preliminary Report No. 2. Notes on Damage by Water in California Oil Fields, March, 1914. By R. P. McLaughlin. 4 pp.	----
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**Preliminary Report No. 7. The Clay Industry in California. By E. S. Boalich, W. O. Castello, E. Huguenin, C. A. Logan, and W. B. Tucker, 1920. 102 pp. 24 illustrations. Paper	----

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**Preliminary Report No. 8. A Review of Mining in California During 1921, with Notes on the Outlook for 1922. By Fletcher Hamilton, 1922. 68 pp. Paper	----

MISCELLANEOUS PUBLICATIONS

**First Annual Catalogue of the State Museum of California, being the collection made by the State Mining Bureau during the year ending April 16, 1881. 350 pp.	----
**Catalogue of books, maps, lithographs, photographs, etc., in the library of the State Mining Bureau at San Francisco, May 15, 1884. 19 pp.	----
**Catalogue of the State Museum of California, Volume II, being the collection made by the State Mining Bureau from April 16, 1881, to May 5, 1884. 220 pp.	----
**Catalogue of the State Museum of California, Volume III, being the collection made by the State Mining Bureau from May 15, 1884, to March 31, 1887. 195 pp.	----
**Catalogue of the State Museum of California, Volume IV, being the collection made by the State Mining Bureau from March 30, 1887, to August 20, 1890. 261 pp.	----
**Catalogue of the Library of the California State Mining Bureau, September 1, 1892. 149 pp.	----
**Catalogue of West North American and Many Foreign Shells with Their Geographical Ranges, by J. G. Cooper. Printed for the State Mining Bureau, April, 1894	----
**Report of the Board of Trustees for the four years ending September, 1900. 15 pp. Paper.	----
Bulletin. Reconnaissance of the Colorado Desert Mining District. By Stephen Bowers, 1901. 19 pp. 2 illustrations. Paper.	Free
Commercial Mineral Notes. A monthly mimeographed sheet, beginning April, 1923	Free
Leaflet, Mining Law (reprint). 19 pp.	Free

MAPS

Register of Mines With Maps.

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**Register of Mines, with Map, Butte County	----
**Register of Mines, with Map, Calaveras County	----
**Register of Mines, with Map, El Dorado County	----
**Register of Mines, with Map, Inyo County	----
**Register of Mines, with Map, Kern County	----
**Register of Mines, with Map, Lake County	----
**Register of Mines, with Map, Mariposa County	----
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Register of Oil Wells, with Map, Los Angeles City (1906)	.35

OTHER MAPS

**Map of California, Showing Mineral Deposits (50 x 60 in.)	----
**Map of Forest Reserves in California	----
**Mineral and Relief Map of California	----

OTHER MAPS—Continued

Asterisks (**) indicate the publication is out of print.

	Price
**Map of El Dorado County, Showing Boundaries, National Forests	----
**Map of Madera County, Showing Boundaries, National Forests	----
**Map of Placer County, Showing Boundaries, National Forests	----
**Map of Shasta County, Showing Boundaries, National Forests	----
**Map of Sierra County, Showing Boundaries, National Forests	----
**Map of Siskiyou County, Showing Boundaries, National Forests	----
**Map of Tuolumne County, Showing Boundaries, National Forests	----
**Map of Mother Lode Region	----
**Map of Desert Region of Southern California	----
Map of Minaret District, Madera County	$0.20
Map of Copper Deposits in California	.05
**Map of Calaveras County	----
**Map of Plumas County	----
**Map of Trinity County	----
**Map of Tuolumne County	----
Geological Map of Inyo County. Scale 1 inch equals 4 miles	.60
**Map of California accompanying Bulletin No. 89, showing generalized classification of land with regard to oil possibilities. Map only, without Bulletin	----
Geological Map of California, 1916. Scale 1 inch equals 12 miles. As accurate and up-to-date as available data will permit as regards topography and geography. Shows railroads, highways, post offices and other towns. First geological map that has been available since 1892, and shows geology of entire state as no other map does. Geological details lithographed in 23 colors. Unmounted	.75
Mounted	2.00
Topographic Map of Sierra Nevada Gold Belt, showing distribution of auriferous gravels, accompanying Bulletin No. 92 (also sold singly) In 4 colors	.50

OIL FIELD MAPS

These maps are revised from time to time as development work advances and ownerships change.

Map No. 1—Sargent, Santa Clara County	.50
Map No. 2—Santa Maria, including Cat Canyon and Los Alamos	.75
Map No. 3—Santa Maria, including Casmalia and Lompoc	.75
Map No. 4—Whittier-Fullerton, including Olinda, Brea Canyon, Puente Hills, East Coyote and Richfield	.75
Map No. 5—Whittier-Fullerton, including Whittier, West Coyote and Montebello	.75
Map No. 6—Salt Lake, Los Angeles County	.75
Map No. 7—Sunset and San Emidio and Kern County	.75
Map No. 8—South Midway and Buena Vista Hills, Kern County	.75
Map No. 9—North Midway and McKittrick, Kern County	.75
Map No. 10—Belridge and McKittrick, Kern County	.75
Map No. 11—Lost Hills and North Belridge, Kern County	.75
Map No. 12—Devils Den, Kern County	.75
Map No. 13—Kern River, Kern County	.75
Map No. 14—Coalinga, Fresno County	1.00
Map No. 15—Elk Hills, Kern County	.75
Map No. 16—Ventura-Ojai, Ventura County	.75
Map No. 17—Santa Paula-Sespe Oil Fields, Ventura County	.75
Map No. 18—Piru-Simi-Newhall Oil Fields	.75
Map No. 19—Arroyo Grande, San Luis Obispo County	.75
Map No. 20—Long Beach Oil Field	1.25
Map No. 21—Portion of District 4, Showing Boundaries of Oil Fields, Kern and Kings counties	.75
Map No. 21A—Portion Kern and Kings counties	.75

OIL FIELD MAPS—Continued

	Price
Map No. 22—Portion of District 3, Showing Oil Fields, Santa Barbara County	$0.75
Map No. 23—Portion of District 2, Showing Boundaries of Oil Fields, Ventura County	.75
Map No. 24—Portion of District 1, Showing Boundaries of Oil Fields, Los Angeles and Orange counties	.75
Map No. 26—Huntington Beach Oil Field	.75
Map No. 27—Santa Fe Springs Oil Field	.75
Map No. 28—Torrance, Los Angeles County	.75
Map No. 29—Dominguez, Los Angeles County	.75
Map No. 30—Rosecrans, Los Angeles County	.75
Map No. 31—Inglewood, Los Angeles County	.75
Map No. 32—Seal Beach, Los Angeles and Orange counties	.75
Map No. 33—Rincon, Ventura County	.75
Map No. 34—Mt. Poso, Kern County	.75
Map No. 35—Round Mountain, Kern County	.75
Map No. 36—Kettleman Hills, Kings County	1.25
Map No. 37—Montebello, Los Angeles County	.75
Map No. 38—Whittier, Los Angeles County	.75
Map No. 39—West Coyote, Los Angeles and Orange counties	.75
Map No. 40—Elwood, Santa Barbara County	.75
Map No. 41—Potrero, Los Angeles County	.75
Map No. 42—Playa Del Rey, Los Angeles County	.75

DETERMINATION OF MINERAL SAMPLES

Samples (limited to three at one time) of any mineral found in the state may be sent to the Division of Mines for identification, and the same will be classified free of charge. No samples will be determined if received from points outside the state. It must be understood that no assays, or quantitative determinations will be made. Samples should be in lump form if possible, and marked plainly with name of sender on outside of package, etc. No samples will be received unless delivery charges are prepaid. A letter should accompany sample, giving locality where mineral was found and the nature of the information desired.

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STATE OF CALIFORNIA

DEPARTMENT OF NATURAL RESOURCES

DIVISION OF MINES

CORDIALLY INVITES YOU TO VISIT
ITS VARIOUS DEPARTMENTS MAINTAINED
FOR THE PURPOSE OF FURTHERING
THE DEVELOPMENT OF THE

MINERAL RESOURCES OF
CALIFORNIA.

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Office hours: 9 a.m. to 5 p.m. daily
Saturday, 9 a.m. to 12 m.

Walter W. Bradley,
State Mineralogist.

Third floor, Ferry Building, San Francisco, Cal.

Branch Offices: New Orpheum Building, Los Angeles; State Office Building, Sacramento; Chamber of Commerce, Redding; Bank of Italy Building, Bakersfield; San Marcos Building, Santa Barbara; Taft, Coalinga and Santa Paula.

Mining in California

OCTOBER, 1930

PUBLISHED QUARTERLY

STATE OF CALIFORNIA
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF MINES

FERRY BUILDING
SAN FRANCISCO

DIVISION OF MINES

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STATE OF CALIFORNIA
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF MINES
FERRY BUILDING, SAN FRANCISCO

WALTER W. BRADLEY — State Mineralogist

Vol. 26 — OCTOBER, 1930 — No. 4

CHAPTER OF

REPORT XXVI OF THE STATE MINERALOGIST

COVERING

ACTIVITIES OF THE DIVISION OF MINES

INCLUDING THE

GEOLOGIC BRANCH

CALIFORNIA STATE PRINTING OFFICE
HARRY HAMMOND, STATE PRINTER
SACRAMENTO, 1931

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PREFACE

The Division of Mines (formerly State Mining Bureau) is maintained for the purpose of assisting in all possible ways in the development of California's mineral resources.

As one means of offering tangible service to the mining public, the State Mineralogist for many years has issued an annual or a biennial report reviewing in detail the mines and mineral deposits of the various counties.

The weak point in work of that character was that the results of field investigations were so long in preparation that they had lost much of their usefulness by the time they finally appeared in print.

As a progressive step in advancing the interests of the mineral industry, publication of the Annual Report of the State Mineralogist in the form of monthly chapters was begun in January, 1922, and continued until March, 1923.

Owing to a lack of funds for printing, this was changed to quarterly publication, beginning in September, 1923.

For the same reason, beginning with the January, 1924, issue, it has been necessary to charge a subscription price of $1 per calendar year, payable in advance; single copies, 25 cents apiece. 'Mining in California' will continue to be sent without charge to our exchange list, including schools and public libraries, as are also other publications of the Division of Mines.

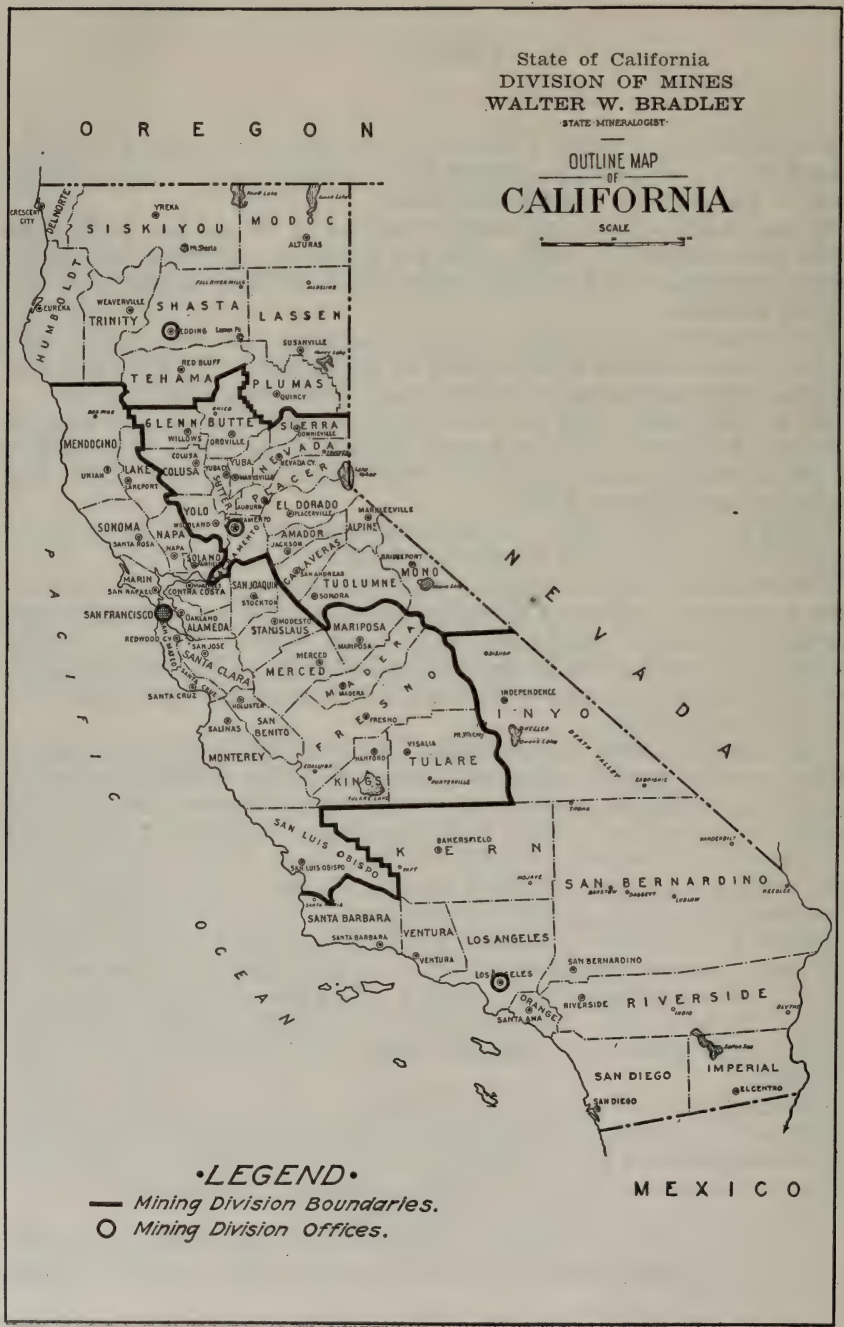
Pages are numbered consecutively throughout the year and an index to the complete reports is included annually in the closing number.

Such a publication admits of several improvements over the old method of procedure. Each issue contains a report of the current development and mining activities of the State, prepared by the district mining engineers. Special articles dealing with various phases of mining and allied subjects by members of the staff and other contributors are included. Mineral production reports formerly issued only as an annual statistical bulletin are published herein as soon as returns from producers are compiled. The executive activities, and those of the laboratory, museum, library, employment service and other features with which the public has had too little acquaintance also are reported.

While current activities of all descriptions will be covered in these chapters, the practice of issuing from time to time technical reports on special subjects will be continued, as well. A list of such reports now available is appended hereto, and the names of new bulletins will be added in the future as they are completed.

The chapters will be subject to revision, correction and improvement. Constructive suggestions from the mining public will be gladly received, and are invited.

The one aim of the Division of Mines is to increase its usefulness and to stimulate the intelligent development of these remarkably diversified resources of the State of California.


State of California
DIVISION OF MINES
WALTER W. BRADLEY
STATE MINERALOGIST
OUTLINE MAP
OF
CALIFORNIA
SCALE
OREGON
NEVADA
PACIFIC OCEAN
MEXICO
DEL NORTE
HUMBOLDT
SISKIYOU
MODOC
TRINITY
SHASTA
LASSEN
TEHAMA
PLUMAS
GLENN
BUTTE
SIERRA
MENDOCINO
NEVADA
LAKE
COLUSA
YUBA
PLACER
YOLO
EL DORADO
SONOMA
NAPA
AMADOR
SOLANO
ALPINE
MARIN
CONTRA COSTA
SAN JOAQUIN
TUOLUMNE
MONO
SAN FRANCISCO
ALAMEDA
STANISLAUS
MARIPOSA
SANTA CLARA
MERCED
MADERA
INYO
SAN BENITO
MONTEREY
FRESNO
TULARE
KINGS
SAN LUIS OBISPO
KERN
SAN BERNARDINO
SANTA BARBARA
VENTURA
LOS ANGELES
ORANGE
RIVERSIDE
SAN DIEGO
IMPERIAL
•LEGEND•
Mining Division Boundaries.
Mining Division Offices.

DISTRICT REPORTS OF MINING ENGINEERS

In 1919–1920 the Mining Bureau was organized into four main geographical divisions, with the field work delegated to a mining engineer in each district, working out from field offices that were established in Redding, Auburn, San Francisco and Los Angeles, respectively. This move brought the office into closer personal contact with operators, and it has many advantages over former methods of conducting field work. In 1923 the Redding and Auburn field offices were consolidated and moved to Sacramento.

The Redding office was reestablished in 1928, and the boundaries of each district adjusted. The counties now included in each of the four divisions, and the locations of the branch offices, are shown on the accompanying outline map of the State. (Frontispiece.)

Reports of mining activities and development in each division, prepared by the district engineer, will continue to appear under the proper field division heading.

Although the petroleum industry is but little affiliated with other branches of mining, oil and gas are among the most valuable mineral products of California, and a report by the State Oil and Gas Supervisor on the current development and general conditions in the State's oil fields is included under this heading.

County Reports.

The series of separate reports on the mines and mineral resources of the different counties, that together comprise the State Mineralogist's Reports XIV to XVII, inclusive, in the case of many of the counties having become exhausted and those still in stock being in need of revision, a new series was begun with the January, 1925, issue of 'Mining in California,' by making the district engineers' reports in the form of a complete general report on the mines and mineral resources in one or more of the counties in each district.

This program was followed as nearly as possible in succeeding numbers of the quarterly until with the current issue (October, 1930) the entire state has again been covered.

Special, Substance Reports.

Forthcoming issues will contain reports upon the state's resources of specific economic minerals, particularly among the non-metallic groups.

REDDING FIELD DIVISION

CHAS. VOLNEY AVERILL, Mining Engineer

There is no report from the Redding Field Division, as the present series of county reports is complete for that district, and Mr. Chas. V. Averill, District Mining Engineer, is engaged on geological field studies in the Shasta Quadrangle.

SACRAMENTO FIELD DIVISION

C. A. LOGAN, Mining Engineer

BUTTE COUNTY

Geography.

The western half of Butte County lies in the Sacramento Valley and is entirely an agricultural region, while to the north and east of Oroville the foothills rise into mountain ridges several thousand feet high, separated by deep canyons occupied by the forks of Feather River.

The Southern Pacific Railroad's Shasta Route traverses the western or valley portion from north to south, with a branch through Honcut to Oroville, and another from Chico to Stirling City via Magalia. The Western Pacific Railway, entering Oroville from the south, follows the canyon of the North Fork of Feather River northeastward into Plumas County. The Sacramento Northern, an electric short line, runs from Sacramento north to Oroville Junction, with branches to Chico and Oroville. The county is adequately covered by a network of good roads.

Mineral Resources.

The placer gold production has been heavy, and the complete record would show several times the amount in the table, as the surface placers worked in the early days were extremely rich. An estimate of $200,000,000 total gold output has been made, but there are no definite figures previous to 1880 to support this except for the Cherokee (Spring Valley) Mine. Gold quartz has yielded a few million. Next in importance has been the stone industry, in this county a by-product of gold dredging. Mineral water, chromite, manganese, silver, platinum group metals, brick, lime, soapstone and mineral paint have each been produced in smaller quantities. Several hundred diamonds have been found during placer mining.

Water, Power and Timber.

The drift mines in general develop from their own workings enough water for washing the small tonnages of gravel mined, and quartz mines generally have enough for milling. There is not enough water available for direct use for power, in many cases, and what there is that could be used for this purpose is too costly, particularly in the case of the supply in the Forbestown mining district, where the Oroville–Wyandotte Irrigation District controls the supply and charges a high price. The supply for surface placer mining is limited. The water formerly used for hydraulic mining has been taken by power companies and farmers. Pacific Gas and Electric Company operates two hydro-electric plants at De Sabla and Centerville on Big Butte Creek. Great Western Power Company of California has a large generating plant at Las Plumas.

There is a good supply of timber for mining in all of the mining districts.

Acknowledgment.

The writer wishes to acknowledge with pleasure the assistance given by mine owners and operators. Special thanks are due to the late M. J. Cooney and George A. White, Forbestown; E. N. Understock and Nat Lambert, De Sabla; H. Bartram, Coutolenc; R. L. Phillips and A. H. Hugh, Nimshew; J. A. Moore, Maurice Reich, J. A. Pitts and Charles Bader, Magalia; John Wells and Sidney Wellington, Yankee Hill; Mr. and Mrs. Carl Johnson, Berry Creek; Howard Silsbee, Mountain House; A. Delerey, Paradise; Harry Sheehy and Forest Snow, Berdan.

MINERAL PRODUCTION OF

Year	Diamonds, value	Gold, value	Mineral water		Platinum	
			Gallons	Value	Ounces	Value
1880		$430,501				
1881		650,000				
1882		650,000				
1883		630,000				
1884		680,000				
1885		672,569				
1886		728,160				
1887		632,902				
1888		550,000				
1889		696,628				
1890		268,977				
1891		304,765				
1892		316,999				
1893		307,351				
1894		473,673				
1895		697,261				
1896		749,316	1,900	$775		
1897		667,025	2,160	900		
1898		514,508	2,685	900		
1899		486,846	2,480	1,240		
1900		485,589	15,000	1,515		
1901		864,978	10,400	1,455		
1902		916,782	14,000	1,500		
1903		1,571,507	13,000	1,550	14	$210
1904		1,932,552	12,600	1,512	66	1,000
1905		2,607,500	15,000	1,500	110	1,770
1906		3,016,747	19,500	1,950	26	475
1907		2,786,840	21,400	2,140		
1908		3,139,398	22,450	2,450		
1909		2,987,079	25,400	1,400		
1910		2,487,791				
1911	$150	2,323,396				
1912		2,346,229				
1913	175	2,269,849	1,000	250		
1914	100	1,700,000	1,200	300	119	381
1915	300	1,545,976	5,000	850	126	3,997
1916	357	1,257,231	3,150	1,125	76	3,472
1917	125	922,271	3,500	1,450	119	9,106
1918	125	645,975	3,900	1,680	114	7,723
1919	[2]	378,297	6,532	2,388	33	5,071
1920	400	467,900	6,400	5,200	fine oz. 42	4,714
1921	331	456,760	2,900	4,100	31	2,432
1922	225	491,201	2,835	2,485	fine oz. 30	3,826
1923		487,393	3,700	3,300	fine oz. 19	2,601
1924		484,530	6,000	4,500	fine oz. 20	2,829
1925		355,289	4,484	2,742	fine oz. 56	9,177
1926	175	287,853			fine oz. 10	954
1927		143,494				
1928		48,432	2,190	1,045		
1929	[8]550	71,917				
Totals	$3,013	$30,588,237	341,866	$52,202	1,011	$63,168

[1] Includes crushed rock, rubble, rip-rap, sand and gravel.
[2] See under "Unapportioned."
[3] Includes diamonds, natural gas, soapstone.
[4] Includes natural gas and soapstone.
[5] Includes brick, copper, gems (diamonds), lead, natural gas, soapstone.
[6] Includes clay (pottery), mineral water, natural gas, soapstone.
[7] Includes copper, gems (diamonds, sapphires), natural gas and soapstone.
[8] Diamonds and precious serpentine.
[9] Includes brick, mineral water, natural gas and soapstone.

BUTTE COUNTY, 1880-1929

Silver, value	Miscellaneous stone[1], value	Miscellaneous and unapportioned		
		Amount	Value	Substance
$1,247				
1,000				
3,700				
13				
6				
500				
518				
5,815				
229				
610				
5,504				
8,936				
5,390				
7,885		700 M	$4,200	Brick.
9,317		250 M	1,500	Brick.
		150 tons	3,000	Mineral paint.
5,009		300 M	1,800	Brick.
		900 tons	9,900	Mineral paint.
13,082		600 bbls.	600	Lime.
4,634		900 M	7,200	Brick.
		1,500 bbls.	1,500	Lime.
2,219		800 M	5,000	Brick.
		400 bbls.	750	Lime.
		1,200 M	7,200	Brick.
358		250 bbls.	250	Lime.
		190 tons.	250	Limestone.
2,302		670 M	4,020	Brick.
7,134		400 M	3,200	Brick.
10,853		130 M	1,300	Brick.
8,967				
12,708	$7,916			
7,205	32,140	200 M	1,200	Brick.
			107,170	Unapportioned, 1900-1909
6,429	34,932	645 lbs.	27	Lead.
5,102	78,208			
5,567	51,879			
5,163	258,503			
4,000	50,895	513 lbs.	20	Lead.
		90 lbs.	4	Lead.
3,433	67,143		540	Chromite.
		11 lbs.	2	Copper.
3,332	67,892	1,451 tons	13,940	Chromite.
			9,576	Other minerals.
		5,746 tons	104,085	Chromite.
2,991	89,870	378 lbs.	32	Lead.
			329	Copper, manganese, natural gas.
2,410	77,822	3,325 tons	134,535	Chromite.
			2,765	Manganese and natural gas.
1,911	92,765		1,105	Gems and natural gas.
2,253	[2]		161,095	Natural gas and miscellaneous stone.
1,759	203,900		548	Other minerals.
1,890	220,450		548	Other minerals.
1,756	340,250		6,648	Other minerals.[3]
2,118	138,000		225	Gems.
			9,548	Other minerals.[4]
4,354	156,738		17,878	Other minerals.[5]
2,997	147,604	273 M	4,316	Brick.
			18,046	Other minerals.[6]
371		40 lbs.	5	Copper.
		130 lbs.	8	Lead.
729	556,301	960 M.	16,320	Brick.
			17,481	Other minerals.[7]
175	485,187		4,108	Limestone.
			22,382	Other minerals.[8]
$183,510	$3,158,395		$706,156	

CHROMITE[1]

Chromite was found in many parts of the county between 1915 and 1918, as shown by the following tabulation, which is abstracted from Bulletin 76, to which the reader is referred for fuller details, as there has been practically no new development in this branch of mining since 1919, and all chromite mines are idle now.

The mines along the flanks of the Magalia ridge as far north as Stirling City are within hauling distance of the railroad. The deposits there are generally in the canyons where erosion has cut through the lava and soil cover and has exposed the serpentine, which occurs in lenses striking generally northwest, and carrying chromite either in bunches or as disseminated ore, the latter requiring concentration.

In the eastern part of the county, there is no lava covering. A large serpentine area is traversed by North Fork of Feather River north of Big Bend and there are other occurrences near Mountain House, Quartz Hill, three to six miles east of Forbestown and in the extreme southeast part of the county.

Table of Chromite Properties in Butte County

Name	Location Sec.	Twp.	Range	Nearest R. R. shipping point and distance
Agard & Stewart	36	23	4	1 mile Pulga
Curtis	7	21	4	Oroville
Dowden				15 miles Blinzing
Hendricks	34	22	4	Oroville
Hendricks No. 2	6	21	4	Oroville
Lambert	34	23	3	5 miles Magalia
Lucky Strike		Woodleaf		30 miles Oroville
Dickie & Dreisbach		Clipper Mills		30 miles Oroville
Noyes				
Rohrer & McCroskey	36	23	4	28 miles Oroville
Sharrer	10	19	7	30 miles Oroville
Simmons				
Stokes				
Swayne				
Union Chrome				
Wakehama	35	23	3	19 miles Oroville
Wells Mine				
Zenith	6	19	7	26 miles Oroville

CLAY

Lund Brick Plant. N. E. Lund, 290 Villa street, Oroville, owner and operator. The plant and pit are 3.7 miles east of Coxlane spur on the Southern Pacific Railroad between Palermo and Honcut. The deposit is of interest because the clay being used overlies an auriferous gravel channel, and the removal of clay will facilitate the working of the gravel, which first attracted the owner.

The following is a section of the deposit:

2 feet soil and gravel overburden.
5–6 feet red mottled sandy clay (fat).
5–6 feet red mottled sandy clay (leaner).
26 feet light sandy clay (decomposed sand).
? gold bearing channel, depth unknown, containing fine and coarse red gravel and large boulders, with a good deal of quartz.

Lund's first work was to sink five shafts averaging 40 feet deep to gravel; there are 10 such shafts in all, which were stopped before reaching bedrock by the influx of water. An adit was run 580 feet in

[1] Cal. State Min. Bur. Bull. 76, pp. 118–121; 216.

rim gravel without reaching the channel trough, and was lost by caving. A good prospect is reported.

Clay is dug with a dragline scraper, raised by bucket elevator to rolls, then elevated to a bin from which it goes to pug mill, auger machine and cutter. A set of tunnel driers has been built lately, requiring $2\frac{1}{2}$ days for steam drying or four days by air circulation alone. There is also an outside drier. The capacity of machinery is 20 M daily. Oil fuel and steam power are used.

Mammoth tusks found near Oroville, Butte County, California.
Photo by Walter W. Bradley.

The different strata of clay have to be mixed to obtain a good red brick of pleasing color. Roofing granules are made from waste. Three shades of this, called cherry, light red and blue-red are sold. Bricks are burned in field kilns.

W. F. Dietrich reported tests on material from this property and discussed its ceramic qualities in Bulletin 99 of this Division, recently published.

It was in the pit at this property that the mammoth tusks described by G. Dallas Hanna (in 'Mining in California' for January, 1929) were found. The tusks lay at a depth of 34 feet below the surface in a sand layer below the clay, and were discovered in November, 1928, by Nelson Lund and son. One of these tusks measured 12 feet 3 inches in length around the outer curve, being only seven inches shorter than the longest of the kind of which there is a record, according to Hanna.

The brick plant on this property was idle when visited late in 1930.

Table Mountain Clay Products Company has a brick plant at Thermalito and 40 acres of clay land 6 miles distant in SW¼ Sec. 22,

Mr. Nelson E. Lund, discoverer, and the Mammoth tusks.
Photo by Walter W. Bradley.

T. 20 N., R. 3 E., on the Oroville–Pentz highway. L. F. Riley, president and manager. Frank Terrill, superintendent.

The plant has a capacity of 20,000 bricks daily. Roofing tile and partition tile are made, as well as common and rug brick. The brick are of a pleasing shade, lighter than commonly seen, and of good quality.

The clay pit carries a thin basaltic capping and about 6 feet of grey volcanic mud, burning dark red. This is underlain by light-colored clay of the Ione foundation, of which 4 feet is pure white. It was prospected by auger holes up to 22 feet deep and in one place 72 feet.

It is mined with scrapers and hauled to the plant in three trucks, where it is dumped to the dry pan and elevated to a bin; that coarser than 60-mesh is returned to the pan. It is worked in an auger machine

and bricks are cut by hand. After drying in the sun about two weeks, bricks are burned 6 days in oil-fired field kilns of 185,000 bricks each. Machinery is operated by electric power. The plant is served by Sacramento Northern Railway.

The ceramic qualities of a sample of clay from this property were tested, and discussed by W. F. Dietrich in Bulletin 99, recently published by this division.

The brick plant here was idle in 1929 and 1930.

COPPER

A little cement copper was produced from the concentrate at the Gold Bank Mine after chlorination. The ores of the Bonanza King prospect and the Evening Star claim (which see) carry copper, as do others noticed, but no production of this metal is being made.

FUELS

Lignite has been found in the Oroville district in wells drilled for water and oil. This lignite occurs in association with the Ione formation, which borders the foothills on the east and northeast sides of the valley. In geologic mode of occurrence it is similar to that found at Ione, Amador County, and Lincoln, Placer County, where lignite occurs interbedded in nearly horizontal, saucer-shaped bodies in clay and sand at depths seldom over 125 feet below the present surface.

Natural gas in small amount has been produced from a single well in this county, at Richardson Springs.

Lott Ranch. C. F. Lott, owner, Oroville. This property is 8½ miles by road from Oroville in Sec. 12, T. 20 N., R. 3 E., in Coal Canyon, at an elevation of 500 feet. There are reported to be two strata of brown lignite at depths of 20 and 30 feet below the surface, but the old workings were obliterated by a washout and slide several years ago and the beds in place underground are not now accessible, although there is considerable lignite in the old dumps.

Between 1860 and 1880 this lignite was used in Oroville for fuel and for making gas. There is no one now alive in the neighborhood who knows the extent of the underground workings, but an old report[1] states the coal was about six feet thick and was drifted for "several hundred feet." A sample taken in 1920 by the writer from the old dump was too much oxidized to permit any test of its properties.

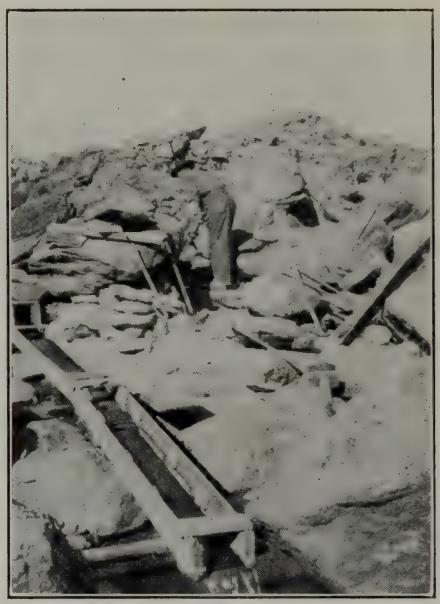
GEMS

Californite (California *Jade*) occurs at the Jade Mountain Mines near Pulga, on the Western Pacific Railway in the canyon of North Fork of Feather River. Some work has been done upon the property and an attractive exhibit was made at the State Fair in 1927. J. R. Grant, 418 Turk street, San Francisco, manager. W. H. King, Pulga, secretary.

Diamonds have been found at intervals from the early days in the placer mines of Cherokee and Morris Ravine and these finds have continued up to the present time, although mining has almost ceased there. Eakle stated[2] in 1922 that more than 300 good diamonds have been obtained from the placers of the Cherokee district. All were

[1] State Mineralogist's Report XI, p. 166.
[2] Cal. State Min. Bur. Bull. 91, p. 8.

accidental finds in the course of washing the gold-bearing gravel. The source of these diamonds has not been found. The United States Diamond Mining Company prospected some ground unsuccessfully in an effort to find the stones in place some years ago. Though diamonds have been found at times at placer mines in seven other counties, the number found at Cherokee has evidently exceeded all the others combined. They weighed usually up to one carat, but some larger ones were up to two carats in weight. A good many were 'off color.' During 1930, J. S. Presley found one at Cherokee weighing two carats, and F. Zotter one of .6 carat weight.



Chas. E. Grant searching for diamonds in the old mine pit at Cherokee, Butte County.

GOLD (QUARTZ MINES)

The quartz mines of the Forbestown district and of Big Bend Mountain, which have been the most important so far found in the county, occur in greenstone mapped geologically as amphibolite schist, comprising rocks principally of basic igneous character, which have been dynamically altered, changing largely to schists. The influence of the great granodiorite and granite batholith lying between these two districts, and which is bordered by other scattered mines, was probably important in the genesis of the ores, though no important mines have been found here in the granite.

The bedrock formations in the entire western half, and more, of the county are covered, except where reached by erosion, so little can be judged of their character. From observations made by the writer in several drift mine workings, and in the canyons of some of the streams, it appears that the slates and schists of the Calaveras (Carboniferous) series with accompanying basic dikes and serpentine follow

their normal strike northwest, with dip to the northeast, across the Magalia and neighboring ridges, and that the Mariposa (Jurassic) slate occurs to the southwest of that series. The identification of these rocks, as far as it went, was made solely on the striking similarity, lithologically, of the rocks found here to those of these series in the Mother Lode counties. Gold-bearing stringers and pocket deposits in these rocks have furnished the gold which has enriched the old stream channels crossing them. This is certain because all but one or two of these channels now being worked as drift mines carry little rock except greenstone, slate and serpentine, and these channels are nearly all manifestly too small and too short to have reached back into the granite forming the core of the mountains from the vicinity of Stirling City northward. The term 'dike' has been applied to several of these gold-bearing rock series whose courses can be traced at intervals, where the removal of the lava cover reveals them. The channels, flowing southwest, offer interesting evidence of earth movements along the dikes. Nearly every drift mine that has been opened between West Branch of Feather River and Big Chico Creek shows faults that have occurred since the deposition of the gravel, where the channels cross the 'dikes.' In all cases mentioned except one, there is an apparent upthrow on the downstream (southwest) side or a downthrow on the northeast amounting to a displacement of from a few feet to 225 feet, the latter observed at the Black Diamond and Dix Mines (which see).

Associated with the Calaveras and allied rocks are many large quartz veins, which must be in the main 'spotted,' barren or low grade, as no mines of importance have been developed in them in the Magalia or nearby districts. They resemble, and are probably the same in origin as the 'bull quartz' veins of the Mother Lode.

One thing distinguished the quartz mines of the county from those farther south. In Butte County the gold is mostly in the sulphides, and little has been recovered by amalgamation, in the principal mines. A large quartz vein showing little sulphide is apt to be very low grade. Copper sulphides are usually present in small amount. There has been a tendency for sulphides to occur in bunches, rather than scattered through the quartz evenly.

Banner Mine is five miles northeast of Oroville near the Cherokee road. The past operations have been described in the reports cited below. There had been little done since 1916 until *Empress Mining Corporation* took a lease and option on the mine in May, 1929. This is a Nevada corporation with an office in the Humboldt Bank Building, San Francisco. They have been working through the Amosky inclined shaft which had previously been sunk 600 feet at an angle of 35°. The vein had previously been stoped from the 500-ft. level to the surface. The new work has consisted of 70 feet of drifting, 100 feet of crosscuts and a raise 60 feet long from the 600-ft. level; 80 feet of crosscuts on the 500-ft. level and 75 feet on the 300-ft. level. It is claimed that the raise from the 600-ft. level is in ore from two to five feet wide. The workings were not visited, as underground work had been suspended at the time of visit (August 29, 1930) awaiting the outcome of a lawsuit between the owners and the company.

Equipment includes electric pump with a capacity of 300 g.p.m., a 20-h.p. electric hoist, and a Tetrault 4-stamp mill which is said to

have a capacity of five tons in 24 hours. A few tons of quartz has been crushed.

The production in earlier days came largely from the Little Banner vein, which was credited with an output of $600,000 up to 1891. Since 1908 it has belonged to the present owners who claim an output of $81,000 has been made during this later period. The lawsuit for possession was decided in favor of the owners in October, 1930.

Bibl: State Mineralogist's Report XI, p. 153; XIII, p. 82; XV, pp. 211–212.

Berry Creek Mine containing 80 acres is in the E½ of E½ of Sec. 28, T. 21 N., R. 5 E., on the Oroville–Quincy highway. Berry Creek station on the West Pacific Railway is about four miles northwest by road. Elevation, 1900 feet.

The property was worked by C. J. Willett et al., and later by John Kinkaid, and ore was crushed in a 1-stamp mill. It was worked by open cut and a series of short adits on the steep mountain side above (east) of the road, previous to 1910. The present owner, Carl Johnson, Oroville (star route), has driven a new adit 100 feet lower than the lowest old work and this is 175 feet long, with the face in hard granodiorite and with an estimated distance of about 100 feet to go to be directly below the point where pay was found in the adit from the road level. The old workings are caved and inaccessible, and statements as to the size of the vein are conflicting. The ore is variously stated to be from a few inches to five feet wide. It was good grade, several hundred tons yielding a reported average value of $10 a ton on the plates under obviously wasteful milling, with high loss in the tailing; besides this, bunches of rich pocket ore yielded many thousands of dollars. The total output is estimated at from $30,000 to $80,000.

Beginning at the highest workings, there is first an open cut 65 feet long. Seventy feet lower an adit was run, a stope was worked and a drift advanced on the vein from which ore was being taken when the drift was lost by caving from the stope. A winze 20 feet below this level is said to be in pay ore. The adit from the road level is reported to be 200 feet long, with pay ore in a cross vein 15 to 20 feet back from the 2-foot vein which was struck about 70 feet from the portal.

Besides the narrower pay vein which strikes northwest and dips southwest, a wide vein of quartz striking N. 25° E. and dipping east, outcrops on the hillside east of the road. It has been prospected only for pockets. The surface of the hillside pans small quantities of free gold in many places.

Equipment consists of 1-drill compressor, jackhammer drill, gasoline engine and 1-stamp mill, the mill requiring a new building. A water ditch supplying free water crosses the property 80 feet above the lowest adit, as does also the Butte and Plumas Railroad. There are two good houses on the place.

Bloomer Hill (Chambers) Mine comprises 162 acres in NE¼ Sec. 35, T. 21 N., R. 4 E., on Bloomer Hill one mile from Bloomer station on Western Pacific Railway. The railway and North Fork of Feather River cross one corner of the property. J. F. Garrette, owner, Woodland.

The deposit consists of disseminated sulphides and siliceous replacement in amphibolite schist with later oxidation, leaching and kaolinization in the upper section. The schist is derived from earlier igneous rocks, including some porphyry. The footwall of unaltered schistose porphyry strikes N. 20° W. and dips 50° E. Local jointing or movement planes may have been the lines from which the rock masses were acted upon, by the mineralizing solution carrying gold.

The development consists of three adits, two raises and a sub-level. No. 1 adit, said to be 100 feet long and 75 feet below the surface at the face, was not visited. It is said to be all in ore. No. 2 open cut and adit crosscuts the formation for about 125 feet, N. 60° E. at an elevation of 1200 feet. Here an inspection shows mineralized schist, partly leached and kaolinized, with some cores of less mineralized rock. There are three short drifts off this level. The late A. B. Chambers, the former owner and operator, stated that ore milled from one of these averaged over $6 in free gold, and that the entire distance of this crosscut averaged $2.50 to $3 a ton. This level is 125 feet below the outcrop at the face. In this adit 40 feet from the portal, an inclined winze connects with a sub-level 120 feet deeper and with No. 3 adit 200 feet vertically below No. 2. The sub-level, about 100 feet long, shows the fresh, hard mineralized schist unaffected by leaching or kaolinization. No. 3 adit is about 600 feet long, but did not reach ore.

About 1900 the property was equipped with a 15-stamp mill and 4-drill air compressor just below No. 3 adit. Water for power and milling was brought 11 miles from Berry Creek by a ditch which cost over $35,000 and a steel pipe line which gave over 700 feet fall at the mill. Only ore from development work had been milled when the mill and other buildings except the compressor house were destroyed by a forest fire. Several of the buildings were replaced but the mill still lies on the ground and the mine has remained idle for 12 years or more.

Burlington Prospect. Owner, Burlington Gold Mining Company, c/o Mrs. W. C. Ralston, 430 California Street, San Francisco. Comprises lots 54 and 56 in Secs. 3 and 10, T. 19 N., R. 6 E., containing 43.18 acres, near Forbestown.

A vein reported to be six feet wide has been prospected by the Joe adit, 635 feet long, which gives 170 feet of backs at the face. Some ore is reported in this. The Annette adit, about 300 feet long, did not develop ore. This property has been idle a number of years.

Carlisle Mine covers 600 acres, patented, and 40 acres unpatented, all in Sec. 35, T. 20 N., R. 6 E., one to two miles north of Forbestown. Owners, heirs of Mrs. Rose H. Hazelton, and Wm. Denman, San Francisco.

The Carlisle, Big Betsy and Indian Gulch veins occur here. The formations are granodiorite and amphibolite schist, the contact crossing the section almost diagonally in a northeasterly direction. The South Fork of Feather River has cut a deep canyon across the south half making conditions favorable for prospecting the Carlisle vein by adits. Carlisle vein has been developed by a winze 200 feet deep with

three drifts 100 to 110 feet long northeast and one 315 feet long southwest on the vein, opening it for a total length of 425 feet on the 200-foot level. The vein dips 60° northwest. The adit from which the winze was sunk is on the north bank near the river level, and the drift southwest was carried under the river. The vein is reported six to eight feet wide.

A 10-stamp mill was placed on the south bank of the river and connected with the Carlisle workings by tramway, and ore from a small stope above the adit level, as well as that from development, was milled. The ore carries pyrite, galena and copper sulphides in considerable quantity.

The Big Betsy vein strikes east across the extreme northwest part of the property. It showed a reported width of 12 feet where cut in an adit 300 feet long. There is no record of ore milled from it.

The Indian Gulch vein is on the east side of the property. Ninety tons of ore from it is said to have plated $10 a ton. It is about four feet wide and only slightly developed.

Water from the river and from Forbes Ravine might be utilized. Three miles of road would be needed to connect with a road from Enterprise.

Daisy Prospect comprises two claims in SE¼ Sec. 4, T. 21 N., R. 6 E., one mile east of Mountain House at an elevation of 3750 feet. Howard Silsbee and O. G. Thomas, owners, are running an adit to cut a pocket shoot formerly mined in a shaft a little higher. The small veins and stringers of quartz occur at the surface in red and yellow ocher derived from black slate and mica schist, the entire mass of which appears to be out of place as the laminae strike east.

Another vein shows a width up to one foot where it has been trenched for 100 feet northwest. It shows some patches of coarse pyrite which in this region distinguishes the ore veins from those of less value. A depth of only 10 feet has been reached on this vein and there has been no production.

Denver Mine. Charles L. Falk, owner, Woodleaf. Was leased to E. LeG. Reeves of Clipper Mills and Gil Peyton in 1928. It is in the W½ of Sec. 4, T. 19 N., R. 6 E. The lessees were doing some work.

El Monte (Toadtown) Mine is in SW¼ Sec. 36, T. 24 N, R. 3 E. J. A. Frazer, H. M. Mayes and A. Richards have a lease from the owners, *Toadtown Mining Company.*

The old shaft, 150 feet deep on an incline of 45° has been unwatered by the lessees. The north drift, 70 feet long and south drift, 18 feet long, were both being advanced early in October, 1930, on the 150-ft. level. A strike of high-grade ore was made late in September and has yielded several hundred dollars besides fine specimens. The vein forms lenses and stringers under a foot wide in diorite.

Equipment includes 3½-ft. Huntington mill, 10-h.p. gas engine, air compressor and 15-h.p. steam engine, and a small pump and hoist, both operated by 3-h.p. gas engine.

Evening Star Claim is in SE¼ Sec. 8, T. 21 N., R. 5 E., presumably on the south extension of Pinkston vein, 9.5 miles from old Yankee Hill. Elevation 2680 feet (aneroid). John Wells, Yankee Hill, owner.

The Western Pacific Railway is about one mile distant down the steep canyon, but with no road to it. The vein outcrop strikes N. 30° W.

An adit 120 feet long follows the vein on the strike. The deposit is essentially an altered zone of amphibolite schist, mineralized with thickly disseminated pyrite, zincblende and copper sulphides, and leached by descending water near the surface, with some small crusts of azurite and malachite. At 50 feet in the adit, a width of six feet is said to carry $4 to $5 free gold. A winze sunk 12 feet in the adit floor 50 feet from the portal shows an 8-inch vein of heavy sulphide carrying from 6.62% to 13% copper, 1 to 5 oz. silver, 80 cents gold and some zinc. In the adit and crosscuts a width of 50 feet or more is leached and altered to a soft mass of clay and silica.

Water can be had one-half mile distant and 400 feet lower. There is no equipment.

Florence Prospect. Howard Silsbee, owner, Mountain House via Berry Creek. There are two claims, 40 acres, in Sec. 4, T. 21 N., R. 6 E., one-half mile north of Mountain House.

Three veins of quartz, carrying coarse pyrite, strike north in a width of 130 feet. The Rose Quartz or westernmost vein is unprospected as it does not outcrop but was struck accidentally in a hole, where it is said to 'pan.' The Middle or West vein prospects where side stringers make into it. This vein is four feet wide and has been prospected by a shallow tunnel and a shaft 50 feet deep which cuts through it at 14 feet. It dips 80° west. The East vein, nine feet wide, is said to be traceable for one-half mile.

The owner has run a crosscut adit 162 feet to prospect the three veins. He estimates he has 25 feet to go to reach the Rose Quartz, 85 feet to the West and 155 feet to the East vein. Work will be continued during the present year.

Forbestown Consolidated Gold Mines. Estate of M. J. Cooney, and F. G. Stoer, Forbestown, owners. This group includes the Gold Bank Mine of four quartz claims and millsite in NW¼ Sec. 11 and SW¼ Sec. 2; Golden Queen, two quartz claims adjoining Gold Bank on west, on the same vein; Golden King claim, adjoining; all of Section One and N½ of NW¼ of Sec. 12; Oroville No. 1 and No. 2 placers; Shakespeare Mine (three quartz claims lying mostly in Yuba County), E½ of Sec 10, and Miller Mine in Sec. 15 (Yuba County), all in T. 19 N., R. 6 E., and making a total of 1035 acres patented land with other unpatented claims, all near Forbestown.

Because of the past record of the Gold Bank and the possibilities of the different units of the property, it is probably the most interesting and important quartz mining group in the county.

The country rock has been mapped as amphibolite schist, a group name adopted to include a number of ancient igneous rocks which have been in the main altered by dynamic metamorphism. The rock forming the hanging wall of the Gold Bank vein is a hard, dense, fine-grained, dark-green diorite, and blocky rather than schistose. The footwall country rock is syenitic. A large granite batholith lies one mile north, and gabbrodiorite one mile south.

The Gold Bank Mine had been worked previous to 1887, and in 1888 a Huntington mill was in operation, but the principal activity was from 1888 to 1904. In 1890 four 5-foot Huntington mills were in use and the sulphides were being worked by chlorination after being roasted in a reverberatory furnace. Later, stamps were substituted for crushing but chlorination was used throughout the period of operation. Forty stamps were in service for ten years, when 20 more were added, and all 60 were run for six years longer.

The earlier operations were through adits and an inclined shaft on the vein. The Gold Bank and Golden Queen claims are on the south side of the canyon of South Fork of Feather River. The vein strikes about east and has an average dip of 35° north, so that the original operators could have greatly increased their net profits by taking advantage of the topography driving a lower adit and putting the mill below the adit portal. This adit was finally driven but the mill was left above, requiring hoisting of ore. The adit, at an elevation of 1800 feet (altimeter) is 8 by 8 feet in cross section in hard diorite requiring no timber running southwest and cutting the fissure 1275 feet from the portal. At this point, raising on the vein connected the bottom of the shaft with adit, the inclined depth being 1600 feet on dip at adit. From this connection the adit was continued to a total length of 2500 feet without cutting other veins of apparent importance. Nine levels in all were run between the shaft collar and drain adit, besides which five earlier adits had been driven on the east slope, so that the vein was stoped for an inclined depth of 1850 feet on dip. The third and seventh levels, about 1100 feet in length, were the farthest east, and third level was run 1200 feet west, making a total length of about 2300 feet explored on the strike but at only a shallow depth. The largest stope on the Gold Bank (on east side of shaft) was about 450 feet on the strike by 600 feet on the dip. The stoped width where the workings could be seen by the writer in the Gold Bank between levels eight and nine varied from 3 to 11 feet. The ore formed in lenses on both walls; in places both in the Gold Bank and Golden Queen, a lens may be seen on the hanging wall overlapping one on the footwall side of fissure, which may be as wide as 40 feet. The horses of rock between the lenses is apparently the only waste handled in stoping.

The shaft gave access to the *Golden Queen* on the west and this property was worked from 300 level to surface, largely under lease as separate owners had the two mines at the time. Here the stoping was on the hanging wall side and it is said the footwall lenses have not been mined. Where seen on the 300-foot level a footwall lens has a width up to eight feet. There is a possibility of opening up a large block of ore on this side of the mine by extending the levels below No. 3 westward into the Golden Queen. There are also possibilities of opening up more ore on the footwall on the Gold Bank, and the possibility that the lower levels may not be exhausted. Practically no stoping was done on the Golden Queen below the 300-foot level, nor below the ninth level in the Gold Bank.

There is no full and authentic record of the production of either property. The total output of the Gold Bank is placed at $2,000,000,

of which $500,000 was profit. The record of the Golden Queen when operated under lease by the Stow family, owners of the Gold Bank, from October, 1896, to October, 1898, showed 79,689 tons milled which yielded $372,565, according to figures furnished by M. J. Cooney, or net recovery of $4.67 a ton, from which 25% royalty was paid, and a total profit of $132,334 was realized (including royalty). It is said that part of the cost of advancing the lowest adit was also charged. It is reasonable to suppose that the Gold Bank ore was of somewhat similar grade; it was mined and milled for $2.50 a ton (in 1893–1894) exclusive of chlorination of sulphides which cost $7 a ton.

The ore is solid white quartz, with subordinate ribbon structure near the walls. The free gold content is said to be about $1.50 a ton and the sulphides forming 2 to 7% of ore carry the balance, with silver, copper and it is claimed some telluride. The value of sulphide concentrate (principally pyrite with a little copper sulphide, in specimens seen) varied; in 1890 it was reported[1] to be 7% of ore and to carry $85 gold and 9½ ounces silver per ton, and in 1894[2] it was 2% to 3% or ore, yielding $40 per ton in silver and $20 per ton in gold. Elsewhere it is said to be $150 a ton. The sulphide is erratically distributed in bunches, so that hand sampling is apt to give spotty results. A little cement copper was saved. The percentage of recovery was said to have been low in early operations but later was claimed to be 92% to 95% of gold and up to 83% silver. The output of 40 stamps in 1896 was 4300 tons a month and 105 men were employed.

The last work done on the Gold Bank was in 1916, when A. I. Eagle produced about $20,000, shipping concentrate to a smelter and cyaniding slimes.

M. J. Cooney formulated a plan for opening and working the Shakespeare and later the Miller by extending the lowest adit in the Gold Bank southwestward where he expects the Shakespeare vein would be encountered and could be followed on its strike southwest, prospecting the Shakespeare and Miller groups of claims at a vertical depth of from 1000 to 1760 feet. This adit would also offer means of prospecting other veins in the vicinity.

The Shakespeare Mine, first worked in the eighties, was operated a short time about 1892 by Hobart and Lane who installed a 20-stamp mill and reduction plant. A shaft was sunk 230 feet and two levels were run. No. 2 level, the longer and deeper, was carried 350 feet north and about 600 feet south, the latter connecting with a pump incline sunk a short distance from the surface. From a stope carried up from No. 2 level north for a length of about 300 feet, it is stated that $137,000 was produced, but original records of tonnage and value are not available. The ore occurred in a lens, but in the stope was mixed with low-grade material, with a width of 40 feet between walls, and with quartz occurring in stringers. As a result, the recovery by amalgamation was about $3 a ton and concentrate value $35 a ton. The ore is reported to be 16 feet wide and of better grade than above, in a winze sunk 65 feet below No. 2 level, 250 feet north of the shaft. The shaft sump is also said to show six feet of quartz.

[1] State Mineralogist's Report X, p. 127.
[2] State Mineralogist's Report XII, p. 83.

On the No. 2 level south the vein split after being followed 150 feet, and aside from the drift run to connect with the pump shaft little was done on that side, where the face has little depth, due to slope of the surface.

The ore in part resembled that of the Gold Bank, but in running No. 2 level north the ore began to show considerable galena, with high silver content.

The Miller Mine was prospected to a depth of 250 feet by a shaft sunk close to the junction of the Miller and supposed Shakespeare veins. From this shaft the Miller vein was drifted 250 feet and the Shakespeare 370 feet. The ore was reported as carrying about $3 a ton, and apparently there was little production from the 20-stamp mill.

Section one has been prospected only to shallow depth by pocket hunters and 'snipers.' A quartz vein there is reported eight feet wide and carries copper sulphide and free gold as well as the usual pyrite. It is locally considered a good prospect.

The old buildings and equipment on the Gold Bank have been idle and neglected many years and would have to be replaced. The portal of the lowest adit is near the confluence of two ravines and the water from these and from the tunnel could be utilized below on the slope for milling.

Glory Hole Mine adjoins Bloomer Hill Mine. It was a pocket producer up to a few years ago, but is idle now. Pockets were mined in a glory hole, and later by shaft and tunnel.

Gold Mountain Mine. J. B. O'Sullivan, Los Angeles, and E. L. Bacon, owners. Patrick Carton, lessee, Inskip. Comprises two quartz and six placer claims covering entire NW¼ Sec. 28, T. 25 N., R. 4 E., one-half mile northeast of Inskip.

The quartz claims were worked by a company and some production made with a 10-stamp mill 15 years ago. At that time an adit was run 720 feet. Carton began work in the spring of 1928. Four men were employed June 12, when an incline being sunk on a vein 3 to 8 inches wide was down 35 feet. About 150 feet east a shaft was sunk 45 feet, and on the dump here is perhaps 20 tons of quartz stained black and from a vein about one foot wide. The walls are a complex of rotton slaty schist, dikes and soapstone. A large vein runs northeast and if the small one continues to it, pockets may occur at the junction.

Carton was installing a 10-stamp Straub mill in June, 1928, to crush the quartz and stringers in the wall rock which occasionally carry pockets.

I. X. L. Quartz Prospect is in NW¼ Sec. 20, T. 22 N., R. 4 E., on east side of the West Branch of Feather River. Elevation 1500 feet.

A vein 18 inches to 4 feet wide has been prospected in adits 120 feet and 250 feet long, 60 feet apart vertically, and in a shaft 80 feet deep, but higher on the slope. Thirty tons of selected ore is reported to have plated $14 a ton, but a later general sampling returned only $4.11 a ton, according to Sidney Wellington. A vertical range of 150 feet was prospected, and a length of several hundred feet, by the workings.

Lewis Mine comprises three claims in Secs. 2 and 11, T. 19 N., R. 6 E., containing 60 acres, one mile by road east of Forbestown. Harriet Lewis, owner. Eliott Check, Warren Brayton and associates prospected the claims for about a year in 1927–1928.

Development work consists of a series of tunnels and raises connecting with the surface, and a few small stopes. The lowest and principal tunnel is one 1038 feet long running about S. 20° W. at a depth of 395 feet below the surface on the dip at the face. This followed a vein generally 15 inches to 18 inches wide in lenticular form. A small stope near the portal yielded ore which is stated by Check to have plated $8 a ton in former operations. Near the face a raise of 220 feet on vein, and a small stope, connect with an upper crosscut level 400 feet long, near the face of which some small stopes were opened, and connections made with the surface. The distribution of ore is said to be spotted, in an ore zone pitching north. The recent work has not developed enough ore, according to Check, to offer much encouragement. Stopes are about 40 by 30 feet, and up to two feet in thickness of ore was mined.

There is a mill of five small stamps, a rockbreaker and one concentrator. Water power was used formerly, but recently an automobile engine has been substituted for it at a great reduction in cost, as water rates are high. Four men were employed in July, 1928. Work ceased soon afterward.

Matheson Mine, now a part of the *Springer Consolidated* (which see) is on a so-called dike, which in reality is a series of formations corresponding in all respects to the Calaveras (Carboniferous) and associated rocks of the Mother Lode counties, of which it is a continuation on the strike northwest.

The hanging wall of the series is of serpentine, and going across in section to the footwall, the rocks are: Solid 'bull' quartz vein, two feet wide; rusty red-brown decomposed dike rock, with quartz stringers; rotten schist; Calaveras slates, schists, siliceous rocks, 200–300 feet wide. While the entire series is said to carry a little gold, the best pay is reported where stringers from the Calaveras formation intersected cross-faults. Matheson ran a hydraulic cut for 800 feet along the strike on the hanging wall side, and another cut was made on the footwall side, indicating a total width 600 feet. A production of $1,500,000 was claimed. He also operated an 8-stamp mill for a time on a quartz vein exposed by the placer mining.

McClung Prospect comprises two claims on a quartz vein reported to be 4 to 30 feet wide and traceable a long way, on Wild Yankee Creek, a mile south of east of Berry Creek station. C. J. Willett, Harts Mills, ran two adits here 25 years ago. One was 200 feet long on the vein, which assayed $1.50 to $12. This is caved now. The other was a crosscut 110 feet long crossing through the vein, which is said to have a high sulphide content. J. McClung, Harts Mills, has lately relocated the claims.

McHugh Prospect is in $SE\frac{1}{4}$ of $SW\frac{1}{4}$ of Sec. 36, T. 24 N., R. 3 E., adjoining the old Toadtown Mine. P. J. McHugh, Dave Campbell, A. L. Donnelly and others have sunk a prospect shaft which was 18 feet

deep on July 22, 1928, and was on a vein said to prospect well. There is a small pump run by a gasoline engine to keep the shaft unwatered. Idle in October, 1930.

Pinkston Mine is one claim in NE¼ Sec. 8, T. 21 N., R. 5 E., 9.2 miles by road from old Yankee Hill. R. L. Bohannan, owner, Yankee Hill. Elevation 2500–3000 feet.

Pinkston first worked the property about 1890–1895 through an adit 100 feet long about 50 feet below the outcrop. The red oxidized ore was stoped 12 feet wide and 60 feet long, and is reported to have plated $8 to $9 a ton, and to have produced $16,000 with a mill of five small stamps. Work ended when sulphide ore came in. An unusual feature was the occurrence of barytes as a gangue mineral. It is too impure to be of commercial value, however, where seen in the old working.

A new adit has been run perhaps 100 feet lower, in a southerly direction for 110 feet. The formation is amphibolite schist, with schistosity striking N. 30° W. at the face. There a width of 20 feet or more revealed by the diagonal course of the adit, is impregnated with pyrite and small amounts of copper sulphides and zincblende. A number of assays indicated $2.50 to $3 a ton gold, according to John Wells.

Porter Mine is in Secs. 17 and 20, T. 22 N., R. 4 E., 7 miles north of Yankee Hill via Jordan Hill road. Sidney Wellington, owner, 321 Montgomery street, Oroville. Elevation 1740–1900 feet.

It was first worked in the early fifties. A vein of solid quartz, in part brecciated and recemented by brownish silica, is six feet wide and strikes north, dipping 75° east. A large part of it has been worked to a depth of 10 feet for a length of 300 feet and the quartz crushed in arrastres. Porter made some production also previous to 1870. Later an English company and then W. T. Coleman prospected the vein, but there is no record of production by them. An incline shaft is something over 140 feet deep on the vein besides which several adits were run, one 140 feet below the outcrop. There is no equipment.

Rainbow Mine. Millen Griffth Estate, owner, San Francisco. In SW¼ Sec. 29, T. 22 N., R, 4 E., six miles northwest of Yankee Hill on Jordan Hill road.

This mine was discovered on railroad land in 1889 by Wellington who lost it in a lawsuit after producing $9,000. It was later worked until December, 1893, and produced probably $40,000 according to Wellington. A 5-stamp power mill was used.

An inclined shaft was sunk 350 feet on a quartz vein averaging two feet wide, and ore was stoped from three levels from 250 feet deep to the surface. The ore was of good grade, averaging $25 a ton, and being very rich in places, above the 250-foot level, but poor in the bottom of shaft. The vein strikes northeast and is crossed by a dike at the millsite. The old 5-stamp mill lies on the ground.

Silver Moon Group (formerly *Porphyry Point*) is in S½ of NW¼ of Sec. 18, T. 23 N., R. 4 E., and contains about 32 acres. H. Bartram, Coutolenc, owner. Property is on a good road and one-fourth mile from railroad. It covers a dike deposit and a quartz lode in decomposed

dolomitic talc-schist. In the latter, quartz veins occur on both walls of a light gray dike two feet wide with pyrite in coarse cubes. It strikes north and dips east. The quartz is eight inches wide on the hanging wall and 3½ feet wide on the footwall. It carries pyrite in patches, and small amounts of chalcopyrite, but only a few shallow cuts have been made on it. It is probably low grade. A similar deposit, perhaps the same vein, occurs at the old Perschbaker workings.

The dike deposit is of interest geologically and for its mining possibilities. It is so thoroughly decomposed that it is of sandy nature, colored red and yellow, and with seams of quartz up to an inch wide, stained by manganese and carrying gold. Lenses and bunches of rotten dolomitic schist stained by mariposite and thickly pitted with iron oxide derived from pyrite, are residual fragments of the original rock from which the deposit came. There are some patches of partly altered slate also. Serpentine runs parallel on the footwall side. The dike strikes northwest and the exposed lens-shaped body, mostly included in this claim, is 1800 feet long by about 80 feet wide. To the southeast it is covered by a run of lava cobbles, supposedly underlain by a gravel channel.

Some of the deposit has been worked by ground-sluicing in years past and Bartram has mined a little of it with a drag-line scraper. This outfit, operated by a 15-h.p. gasoline engine, has a three-fourths cubic yard bucket and can handle 150 cubic yards in eight hours under favorable conditions. On account of the loss of gold in the coarse quartz which goes out of the sluice in the course of ordinary washing, he plans to install a screen to save the quartz and an arrastre or small mill to crush it. The deposit is susceptible of very cheap operation by the method planned and should yield a profit so long as that method can be followed. Idle in October, 1930.

Southern Cross Mine is in SE¼ Sec. 32, T. 20 N., R. 6 E., about four miles northeast of Enterprise by road and trail, adjacent to South Fork of Feather River. Owner, *Edel Mines Company,* I. L. Rosenthal, president, 177 Post Street, San Francisco. Claims cover 79.96 acres.

The lower adit, about 1800 feet long, enters from the east bank of the river on the southwest end of the Southern Cross claim and runs on the vein through that claim and the Manzanita fractional claim into the Manzanita Extension. The vein strikes southwest and dips northwest in granodiorite. Three small stopes of ore have been mined; one near the portal and one midway in the adit have been carried to the surface, and another near the face has been worked to a height of about 100 feet. Two winzes, each about 75 feet deep, have been sunk below the main adit in the latter two orebodies, the first showing the vein seven feet wide and the second, four feet wide. From the inner winze, lower drifts have been run 105 feet and 95 feet, respectively. Apparently only parts of the orebodies have been stoped above the lower adit. Ore is said to have averaged $8 a ton, with some bunches of higher grade, and high grade concentrate. An upper adit 700 feet long is connected with the lower.

On the opposite side of the river on same level as the lower adit, an adit runs southwest 400 feet, with a winze 50 feet deep about midway

of it, and 30 feet of drifting from the bottom of winze is claimed to be in ore three feet wide.

There is an old mill of four stamps, a ball mill, and old concentrator on the property.

Springer Consolidated Mine. Owner, Springer Consolidated Mining company (disincorporated), c/o W. A. Mitchell, 141 Broadway, New

Springer Consolidated property near De Sabla, showing formations that were mined by steam shovel.

York City. This comprises the Springer Mine, Matheson Mine and a mill site, in all about 45 acres in E½ Sec. 34, T. 24 N., R. 3 E., 6.8 miles by good road from Magalia, the nearest railroad station. Other unpatented claims were formerly held.

The Springer and Matheson claims, respectively, were worked by ground sluicing and hydraulicking for many years by their then owners, Springer and Matheson. The Matheson claim yielded a large sum. It is separately described herein. The Springer, worked on a smaller scale, paid a living to its owner, and undetermined amounts to wandering pocket hunters who worked small seams known to carry coarse crystallized gold. The deposit (described under Matheson) is a belt striking northwest and dipping northeast, composed of serpentine, Calaveras (carboniferous) schist and slate and associated altered and mineralized rocks, all carrying gold in small quantity but with the best pay where seams and stringers in the Calaveras rocks encounter cross faults.

The company in 1915–1917 installed a plant for large-scale operation, spending over $100,000. An open cut was started on the Springer. Rock was churn-drilled and blasted and moved with a steam shovel into chutes delivering to bins. Five ball mills were used for grinding ore and Deister tables for concentrating after amalgamating. It is said a capacity of about 700 tons a day was reached and that work continued over a period of five months. Operations were terminated through the action of the Fish and Game Commission of California and the federal government, who objected to the dumping of tailing into Butte Creek. The property has lain idle since the early part of 1917. When the company started work, they stated the average value per ton milled was expected to be about $1, with a cost of fifty cents a ton for mining and milling. The yield per ton came very close to the estimate, according to John G. Kirchen, general manager, and he believes the project would have been a success had it been allowed to continue.

St. Francis Mine. Mary Hurley, 233 Twelfth avenue, San Francisco, owner. Five claims in Secs. 28, 29, 32 and 33, T. 20 N., R. 6 E., north of Feather River and three miles northeast of Enterprise. It was reported in June that workings which were left in 1924, after a fire, were to be reopened and sampled with the idea of forming a stock company.

Surcease Mine is in the N½ of Sec. 7 and adjoining parts of Secs. 5 and 6, T. 21 N., R. 5 E., 7 miles by road from old Yankee Hill. Berry Creek and Las Plumas on the Western Pacific Railway are each about 2 miles distant in the steep canyon but there is no road connection.

The mine was found on patented railroad land in Sec. 7 by M. P. Kinkaid and was purchased and operated by him and a partner in 1914–1916. In shallow workings near the surface, he is reported to have produced $17,000 from ore that yielded $7 a ton in free gold, with nearly as much in the sulphides. A 1-stamp mill and a Chilean mill were used. The holdings were taken over later by *Goldfield Consolidated Mines and Exploration Company* and other adjoining land acquired. After prospecting the mine, bottoming the ore and blocking it out, they decided it was too small for the scale of operations desired. The *Gruss Mining Company* later took a lease and option on it, but were unable to successfully operate it. After a period of idleness, Marc Latham and Gobel leased the mine on royalty and operated

it at a profit from 1924 to 1927. J. W. Reno and associates later made some production and George P. Brennan and others were preparing to mine more ore in June, 1928. The total production has been over $200,000 to date. The larger part of ore mined averaged $9 a ton; some was much better, yielding $12 a ton or more. Some production has been made in 1929 and 1930.

The country rock is amphibolite schist but a granitic batholith is exposed only two miles southeast. The vein strikes northwest, with the principal ore shoot pitching N. 18° E., being bounded by a fault. The north ore shoot which yielded most of the gold, extended from near the surface to the 210-foot adit level where it appeared to be definitely bottomed as a lower sub-level run by Latham, failed to strike it. This ore shoot was 132 feet in average stope length and 6 feet in average thickness though at times much wider. The vein in the shoot was of solid quartz with subordinate ribbon structure and variable but rather high content of coarse pyrite in patches, carrying a small amount of copper sulphides. Latham reported nearly all the gold was in the sulphides, and quartz with little or no sulphide was low-grade. The south ore shoot apexed about the 210-foot adit level had a pitch length of about 140 feet and a stope length averaging 110 feet. It also has been bottomed, to judge by results of work below it.

The shaft, 610 feet deep, is on an incline of 24° to a depth of 450 feet, there steepening to 40° the rest of the way. It passed diagonally across the fault block containing the two ore shoots. The principal working level was the 210-foot adit, entering from Shields Gulch near the mill and running northwest on the vein 1000 feet or more, crossing the shaft and extending to the north fault. A level above it was run 420 feet southeast and 560 feet northwest and beyond north fault. Below the adit, a level was run both ways and raises put up to prospect for the downward extensions of both ore shoots which did not materialize. The 600-foot level was also run 450 feet southeast and 600 feet northwest giving some good assays but not finding any orebody.

Latham found the ore well adapted to cyanidation. It was ground to minus 30 mesh in a 4-foot by 3-foot ball mill and all cyanided. His operating cost for mining, milling, treatment and marketing bullion was $5.03 a ton. The plant had a capacity of 45 tons in 24 hours, and about 27,000 tons were treated.

Since Latham quit work here, the plant has been changed, first to combined concentrating and cyaniding and later to concentrating, it being planned to ship out concentrates. Equipment in May, 1928, included two 4-foot by 3-foot Hendy ball mills, one Overstrom concentrator, Dorr classifier and 7-inch by 9-inch crusher. An air compressor was to be installed. Electric power is used. A few thousand tons of ore remained in sight to be worked at that time.

Triumph Mine. Owner, Triumph Gold Mining Corporation, 403 Van Nuys Building, Los Angeles. Five claims, containing about 90 acres, are in S½ Sec. 15 and N½ Sec. 22, T. 20 N., R. 7 E., three miles southeast of Lumpkin.

Heretofore, a blanket vein has been worked, which yielded free gold without sulphides on account of the nearness to surface. The mine is

on the north side of canyon of South Fork of Feather River, and is opened by adits. No. 3 adit, 900 feet vertically above the river, is connected with No. 2 adit, over 100 feet higher, by a raise which strikes No. 2 about 200 feet from the portal. The property was not visited. It is reported that the vein was found in an intermediate level between No. 2 and No. 3 adits during the past year, having apparently straightened up to a dip of 70° between definite walls. It is at a contact of granodiorite and 'diorite' where a branch of a granitic batholith intrudes amphibolite. The vein is from 18 inches up in width.

The prospects developed led to the erection of a new mill of five 1250-pound stamps, which was completed in January, 1928. This has 100 square feet of outside amalgamating plates, but no concentrator. A free water supply is taken by two miles of ditch from Knownothing Creek and Devils Ravine. The stamps and rock breaker are operated by separate water power wheels. A few men are employed.

Cañon of Little Butte Creek, Butte County, from Lucky John Mine. The inlets and outlets of several formerly profitable mines were found in this trench.

GOLD (PLACER MINES)

From the earliest days of gold mining in the state, Butte County has been known as a producer of placer gold. The drift mines which were opened after the exhaustion of the surface placers have proved to be mostly on small channels but a few of them, notably the Emma, Indian Springs and Perschbaker, were rich producers over a long period of years. In the main, however, these mines give employment to only a few men each. The principal drift mining section is bounded on the east by the West Branch of Feather River, on the west by Big Chico Creek, and extends from the vicinity of Centerville and Paradise on the south, in a direction a little east of north to the top of the mountain divide in the northeast corner of the county, where the waters of the West Branch are separated from those of the North Fork of Feather River by summits about 6600 feet high. The streams in this

section flow south and southwest, cutting the lava-covered slope into a series of long ridges beneath which are found a multitude of steep, narrow gold-bearing ancient stream channels. None of these so far exploited compare in size or characteristics with the large ancient rivers of the counties farther northeast and southeast, although larger channels have been mined farther southeast in Butte County at Bangor and Cherokee.

The Ione shore line extends northwest, bounding the drift mining district at Cherokee and Mineral Slide (near Paradise). From the points where the ancient streams emptied their loads into this old ocean, and where the erosive action of waves and modern streams resulted in concentration of gold under favorable conditions, southward to Thermalito and Haselbusch, south of Oroville, there existed until about ten years ago some of the richest gold dredging fields ever found. The total area of profitably dredgable ground in the Oroville district was about 6500 acres, taking in part of Oroville townsite and extending southward along Feather River about seven miles with an average width over one mile. Besides this, there were smaller areas, as at Wymans Ravine, Honcut Creek and on Butte Creek, the latter near Chico. The dredging industry in the county reached its zenith between 1900 and 1910. In 1902 there were 35 dredges being operated by 12 companies and in 1908, there were 34 dredgers, which produced over $3,000,000, each of these years, and during the period the county was more than once the leading gold producer of the state. As shown by the analysis of placer gold production from the county (see, post) the dredger output rapidly decreased from 1916 onward. Lately there has been one active dredger in the county, in operation near Haselbusch. The gold dredging operations have been described at length in our past publications.[1]

Hydraulic mining, once carried on at Cherokee on a large scale, and at a few smaller mines, practically ceased in 1915 as far as recorded production is concerned. There appear to be no new data to add in this regard. Many so-called dike deposits exist which have been found to carry enough gold in the superficial oxidized and weathered zone to repay hydraulicking and ground sluicing. Numbers of these have been worked in years past. They are, properly speaking, lode mines and some are described under that head herein, but the production from many of them appears in the tabulation under 'surface' mines.

The following tabulated analysis of placer gold production from Butte County for a number of years gives an idea of the relative importance of the different branches:

[1] State Mineralogist's Report XV; Bull. 57; Bull. 85.

Partial Analysis of Placer Gold Production, Butte County[1]

Year	Dredges		Drift mines		Hydraulic		Surface	
	No.	Amount	No.	Amount	No.	Amount	No.	Amount
1906	15	$2,768,782	12	$102,908	5	$37,220	24	$101,207
1907	35	2,697,092	9	22,158	3	18,375	22	48,103
1908	34	3,043,151	11	13,878	1	12,736	25	56,192
1909		2,890,273						
1910	32	2,389,235	14	47,497	5	15,775	16	15,998
1911	30	2,251,764	12	22,937	4	9,152	28	27,769
1912	28	2,271,996	19	31,545	3	7,205	18	14,182
1913	25	2,122,926	12	43,894	3	4,871	14	62,092
1914	21	1,637,515		43,732		5,034		6,678
1915	17	1,491,006	5	13,746	2	5,644	8	30,910
1916	14	1,210,874	5	12,004			6	15,369
1917	11	893,141		13,984				10,490
1918	8	626,010	6	4,394			7	11,765
1919	6	361,604	4	7,130			7	6,642
1920	4	441,650	4	19,462			7	3,414
1921	4	420,017	1	3,328			8	28,805
1922	4	452,191	6	34,406			5	4,915
1923	4	398,125	8	73,727			11	19,660
1924	4		4	7,092				
1925	4							
1926	Total Placer Production 33 operators, $228,031							
1927	Total Placer Production 32 operators, $143,294							
1928	Total Placer Production 35 operators, $38,431							

Many placer mines in the northeastern part of the county, which are now idle, have been described in U. S. Geological Survey Professional Paper 73, pages 95 to 98. Several of these have been worked out, and there has not been much work done in that section in recent years, so that a full new investigation appeared unnecessary, although a number on which work is being done are mentioned herein.

Very little work has been done in late years at Bangor, where drift mines were formerly worked through shafts.

A few small placer mines, mostly surface sluicing, are worked in winter near Clipper Mills, Hurleton and other sections in the eastern part of the county. Time was not available for visiting these.

Bader Brothers (formerly Mat Bader) *Mine* contains 160 acres in Sec. 36, T. 23 N., R. 3 E., on the east side of Little Butte Creek, one-half mile from Magalia. E. F. Woodworth, lessee, Paradise, prospected the claims from November 15, 1921 to 1929. The production so far has been only nominal, no regular breasting having been carried on by the last operator, but some was done previously.

The main adit runs S. 60° E. for 500 feet and the remaining 800 to 850 feet to the face (July, 1928) has a winding but generally southeast course, running from S 25° E. to S 48° E. at the face. A channel has been encountered but not bottomed. It is evidently the same run of gravel opened in the Pitts Mine, downstream. The main adit has crossed this channel diagonally in a length of 100 feet near the face, having been run from the west rim to the east rim, which was being followed late in July. Good prospects were reported on the east rim. A branch drift running S. 65° E. and 153 feet long, shows rotten porphyry boulders covered by one to two feet of granite sand, and this in turn is covered by lava sand filled with small rotten granite boulders. In holes sunk six feet below this drift near the face, bedrock and good pay gravel are reported. A pump is needed to keep out

[1] Abstracted from Mineral Resources of U S., U. S. Geol. Survey, and U. S. Bur. Mines.

water and permit further work downstream in this direction. The elevation at the portal is 1970 feet.

At a point 900 feet from the portal a drift runs due east 50 feet and southeast 50 feet, where there is a raise 10 feet and an upper level running 150 feet southeast. Here a raise was put up 20 feet on the steep bedrock of the east rim showing large boulders and a good prospect high on the rim.

Three to five men were employed in 1928. A blower for ventilation was run by water power. Hand tools were used, but electric power is available one-fourth mile distant. Water from the workings is stored in a small reservoir for washing gravel. Idle in 1930 on account of lessee's death.

Black Diamond Drift Mine is in E½ of Sec. 34, T. 24 N., R. 3 E., and contains 31.4 acres adjoining the Springer Consolidated Mine. The owners are E. N. Understock, Route A, Oroville, F. and R. Duensing and L. Mecum, Chico. Magalia, on the railroad, is 6.8 miles distant by good road. Lessee, *Butte Mining Company.*

This claim was included in holdings on which the *Indian Springs Channel Gold Mining Company* sank their Kirby shaft 186 feet in 1917, and did some other work without results. A gravel channel traverses the Black Diamond property and the upstream section of it is faulted downward a reported distance of 225 feet by a fault which strikes northwest along the course of the Springer and Matheson dike. The segment of channel southwest of the dike was profitably worked, and the stub of the old adit may be seen in the old open cut of the Matheson Mine, which cuts across the lava-covered channel. The channel courses S. 18° W., and is reported 80 feet wide on bedrock. The lava fill at the surface is about 250 feet wide. The trough is filled with andesite mud and boulders. An upper sand run is underlain by a bench of pay gravel, with the main channel 18 feet lower.

In 1924, an inclined shaft was started by the owners just northeast of the fault and was sunk 280 feet on 40° incline. This apparently struck the southerly rim or a bench as the other rim has not yet been found. A crosscut was run 75 feet west in gravel reported to carry $2 to $3 a cubic yard in the part near bedrock. The gravel is tight, requiring drilling and blasting. The claim is well equipped, having a 40-h.p. boiler, two compressors, hoist, three pumps, air fan, air drill outfit, shop and several buildings. Electric power is two miles distant.

Butte Mining Company, a Nevada corporation, with an office at 381 Bush Street, San Francisco, has taken a lease and option on this mine (September, 1930). It is planned to move machinery from a prospect formerly worked by the company in Calaveras County and put it on the Black Diamond, preparatory to running a tunnel on a sluice grade for a length of about 1100 feet. This would give drainage, and permit underground sluicing. A few men are working at the property (October, 1930) which has been unwatered and partly sampled by the lessee.

Blue Hog Mine. Owner, *Feather River Land and Mining Company,* c/o D. Joseph Coyne, 407–408 Security Building, 510 South Spring Street, Los Angeles. It was last worked in 1920 under lease by Henry

S. Porter with E. F. Woodworth, Paradise, in charge. This work was terminated by a lawsuit concerning the water supply needed to wash gravel. The property is in Secs. 19 and 30, T. 22 N., R. 4 E.

This old mine had been worked at intervals for nearly 40 years. It covers about three-fourths of a mile of a lava capped channel containing loose gravel on slate bedrock. The pay gravel is two to five feet deep and 70 to 100 feet wide. There is a main tunnel which was reported to be 1700 feet long early in 1920 and a drain tunnel 900 feet long. Over 1000 feet of main tunnel is said to have been driven by the last operators and they mined a width of 100 feet for a distance of 400 feet upstream. The lower end of the ground is said to be rich, but a section of channel 2000 feet long is too low to be worked through the present tunnel.

The mine was supposed to have a normal supply of 800 inches of water, but this water right is in conflict with the Paradise Irrigation District. When sufficient water was available, mining was done by piping water to the breast and washing the gravel in sluices laid in the tunnel. The property is equipped with a compressor, 4200 feet of 10-inch to 2-inch pipe and 1700 feet of 14-inch by 16-inch sluice boxes.

Blue Lead Mining Company. W. F. Anderson, president, 901 Hobart Building, San Francisco. This company is working to open the upstream extension of the old Blue Lead channel, near Bangor. The company is controlled through ownership of a majority stock interest by *Robbers Roost Mining Company*, W. F. Anderson, president. In the past, the ground downstream on the gray channel has been worked for a length of 1700 feet up to the present shaft, but no work has been done for many years. Two companies, *Bangor Gold Mining Company* and *Catskill Gravel Mining Company*, formerly operated there. The present company has a lease on 900 acres, covering the gravel deposit from their present workings to the top of the hill, one to two miles northwest of Bangor. The gravel-covered area is from one-half mile to one mile wide on the surface and reaches an elevation of 1000 feet. Where worked in the old mines, the channel was about 80 feet wide in the deeper part, where the gravel is cemented, and 300 feet wide in the upper part.

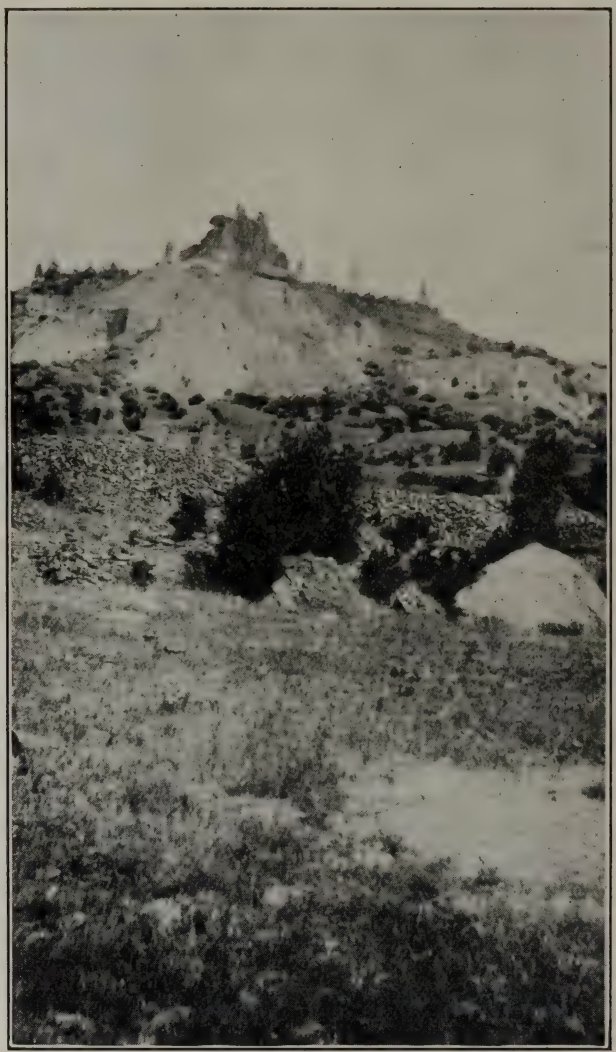
The present company has sunk a shaft to a depth of 84 feet (August 30) in the south rim and have cut through the rim towards a ravine on the north, where the underground workings are only a few feet below the surface. No other work has been done in the channel yet.

Gas engines are used to run the hoist, air compressor and blower. Four men were employed underground and three on the surface.

Cherokee (Spring Valley) Placer Mine has been frequently described in past reports of the State Mining Bureau. It comprised about 1500 acres around the old camp of Cherokee. Owner, Estate of T. L. Vinton, c/o David Vinton, Cherokee.

About 150 acres was hydraulicked to bedrock, with a bank 500 feet high and nearly as much was worked to within 15 feet of bedrock, the lower portion being cemented. The bottom of the channel is flat, and about 700 feet wide. Lindgren believed it was the bed of a broad, steep gulch. For many years this was one of the largest placer gold pro-

ducers of the state. It had a ditch system 94 miles long, supplying 2200 miners' inches of water. During its long period of inactivity, the water rights and ditches have been sold or abandoned, so that at present there is only about 200 inches of free water believed available.



View of Cherokee (Spring Valley) Hydraulic Mine, Butte County.

In later years, it has been worked in a small way as a drift mine and some gravel has been washed during the rainy seasons. An adit has been run 500 feet in the bedrock of the old hydraulic pit, and raises have been put up on both sides. The face of this adit is about under the face of the old hydraulic bank. The raise on the east side is near

the face of the adit and is about 30 feet high, entering fine, free wash quartz gravel with a white sand roof. This gravel has been drifted on east and west 50 feet and according to David Vinton trial lots of it yielded $2.50 a cubic yard. On the west side of the adit, 250 feet in, a crosscut was run 50 feet and a raise put up a few feet into coarse, blue gravel. This layer of gravel carries coarse gold and was the principal productive stratum in the old hydraulic mine. It is partly cemented and lies on a false bedrock of barren wash 10 to 20 feet thick, which in turn rests on the true bedrock. The channel runs southwest and if it maintains the grade indicated here, it should be possible to work about 600 feet downstream from this adit. Recent sampling by Jack Johnson and associates has indicated a gold content which they think may permit profitable operation if work is done in an economical way, utilizing mechanical loading. Plans to resume work have just been announced by Johnson.

To open and work all the remaining portion of this channel would require an adit starting outside this property. Besides the free water supply mentioned, some water could be purchased during part of the year from a power company.

For a full description of the property, the reader should consult the reports cited below. The mine was worked by hydraulicking exclusively from 1858 to October, 1890, having been previously mined in small parcels by many separate owners. The production previous to 1870 was estimated at over $5,000,000. From 1870 to July, 1886, it produced $5,008.208.62.

Bibl: State Mineralogist's Reports VI, Part 2, pp. 24, 25; X, p. 124; XI, p. 155; XIII, pp. 92, 93; XVIII, pp. 258, 259. U. S. Geol. Survey, Prof. Paper 73, pp. 86, 87.

Cory and Strong Placer is 2.8 miles by road north of Stirling City, containing 320 acres in E½ Sec. 16, T. 24 N., R. 4 E., on the west side of West Branch of Feather River. Cory and Strong, owners. *Cory Mine Company, Limited,* lessee, 381 Bush Street, San Francisco.

A large, lava-covered trough with bedrock rims 1500 to 2000 feet apart, crosses the property. The buried ancient river in the bottom of this trough is known locally as the Mammoth Channel. Going upstream on the West Branch about three-fourths mile from the shaft sunk in 1928, and a little north of the property, the present stream enters hard diorite bedrock, and the ancient channel turns east. Going south on the road toward Stirling City, the southeast rim of rotten granitic rock and the lava filling are plainly seen in the cut just west of the road, 1.7 miles south of the shaft.

Years ago, Cory drove an adit 700 feet long about 400 feet south of the north property-line. It is supposed to be on a secondary flow above the deep channel. In 1928, E. L. Williams, W. H. Weimer and Wilbur H. Mallman took a lease upon the claim and started a vertical shaft about midway of the length of the holdings, on the west side of the river 75 feet above the water. This is said to have finally reached a depth of 165 feet without bottoming the channel, and work was stopped. Since then the present lessee has drilled a test hole about three times as deep as this shaft, but have not yet started shaft sinking.

Dix Drift Mine is west of Big Butte Creek in Sec. 22, T. 24 N., R. 3 E., about 9 miles by road from Forest Ranch. It has been prospected during the 7 years ending in 1928 by a partnership, with Harry Sheehy, De Sabla, in charge. Many years ago the upstream part of the property was profitably worked. *Dix Butte Mining Company* was formed to continue work in 1929.

Little West Branch of Big Butte Creek cut the Dix channel in two. The upstream part was worked for a distance of about a mile by the old Portuguese Point hydraulic and drift workings. At the upper end of this work a fault is said to have been encountered which dropped the upstream segment of channel 90 feet, and the Robison prospect lies on the segment. From the crossing of Little West Branch, the Dix channel was followed downstream 3000 feet in the old Dix Mine. Two runs of gravel, with separate rims in places, are reported there. The older channel, capped with rhyolite, is locally stated to have yielded $7 a cubic yard for a width of 30 to 60 feet. A later channel was 'spotty.' This work also encountered a fault, believed to be the same mentioned under the Black Diamond Mine herein, where the upstream segment of channel was dropped (or downstream segment raised) 225 feet. The work was stopped there, and the operations of the present partnership have been directed to finding and working the downstream section.

The mine was temporarily idle when visited in 1928 and the underground workings were not examined. The following data were furnished by Harry Sheehy:

Sheehy and associates have driven a main adit 2350 feet west (elevation at portal 2040 feet) through slate and serpentine bedrock. This struck faulted ground 1900 feet in and was continued 400 feet across a 'dike' which Sheehy identifies as the same as the one described herein under Springer Consolidated Mine. The fault is said to be on the west wall of the 'dike' at a slate-serpentine contact. Near the face a vertical raise was put up 285 feet. An upper level was turned at a point 100 feet above main adit and was run 900 feet N. 30° W., when a raise was put up and struck gravel on the east rim of channel. The upper level was then continued 400 feet farther and position of both channels was determined by several raises. The older rhyolite-capped channel, carrying boulders of granite, slate, serpentine and schist, was found intact 15 feet above the later channel, which is capped by andesite. Crosscutting showed the early channel to be 250 feet wide, and the later 200 feet wide, with a bar or bench of the later channel between. About 300 feet of channel was worked downstream from the fault with disappointing results apparently due to the spreading out of the channels and flat grade.

Work has been carried downstream about as far as can be done from the upper level, and the present plan is to advance the lower adit in the direction of the upper face and then raise again into the channel. A 2-drill compressor is operated by a Pelton water wheel, using free water under 128 feet fall, brought by ditch and pipe from Little West Branch of Butte Creek. The water supply is said to be too small for a few months in summer to permit work. There are some small dwellings on the claims.

Since Dix Butte Mining Company began work, the main tunnel has been driven ahead 800 feet (December 1, 1930) and a raise has been put up 185 feet into the west channel. A crosscut has been run 75 feet across this and several hundred cars of gravel have been washed, which returned a fair average in coarse gold, according to Sheehy. The company plans to continue crosscuting for the east channel, the older and formerly more productive of the two.

Dix Butte Mining Company is a Nevada corporation. F. M. Maloney, secretary, 206 E. C. Lyon Building, Reno, Nevada. Harry Sheehy, superintendent at mine.

Emma (or Nimshew) Drift Mine is in Secs. 14, 15 and 23, T. 23 N., R. 3 E., between Middle Butte and Big Butte creeks. It has been one of the best producers of the county, with a total output of $1,000,000 or more. It was operated and is still owned by *Nimshew Gold Mining Company,* c/o John Erickson, 141 Sutter Street, San Francisco. George Allen has a lease and A. Rugh and R. Phillips are prospecting it. There are 590 acres in the property.

The Emma Channel, running southwest, was worked upstream for 5000 feet, and a branch called the Bootjack, which runs west, was followed 2000 feet. In the first adit a fault with a downthrow of 16 feet on the upstream side was struck 1600 feet from the portal. A new adit was run from which 3400 feet more of the channel was mined. A width of from 12 to 125 feet, but averaging not over 30 feet, was worked. The bedrock is soft, black slate, across which the channel ran at nearly right angles to the cleavage, making an ideal natural riffle, on and within the crevices of which all the pay was found. The grade was variable, being 10 per cent in one section 1200 feet long, where no gravel lodged, and the lava rested directly on bedrock. Here six feet of bedrock was mined as it was easier worked than the lava which made a good roof and still stands without timbers. There was much coarse gold. Where the grade flattened, there was a thickness of 4 to 5 feet of gravel. There was enough grade to permit sluicing the entire distance underground, water coming from a reservoir above.

This channel and its branch were worked upstream at a profit until cut off by a later trough filled with barren lava cobbles and sand. One week's cleanup just before this, yielded 13¼ pounds of gold. Since then, during the past 15 years, close to 5000 feet of prospecting drifts and crosscuts have been run in search of the upstream section of the Emma channel, but all efforts so far have failed. This work is being done now through a crosscut which strikes the crossing of the pay and barren channels about 700 feet underground and at an elevation of 2145 feet (aneroid). This is about one mile north of the old portal.

Ethel Mine. The Ethel adit was run from near the north boundary of Sec. 3, T. 22 N., R. 3 E. It is 1765 feet long. For 1235 feet it was in slate bedrock, passing into lava, which it traversed for 350 feet, then entered gravel in which it was continued for 125 feet. This gravel lay at an incline and was evidently on the rim. After sinking a prospect winze they sank an incline from about the 1500-ft. point in the adit. This incline was about 500 feet long, and was sunk diagonally across

the channel. It is said to have struck the rim and followed a bench, beyond which there was work done at greater depth in gravel, but it is not certain that this bottomed the channel. F. Molin, one of the lessees who worked at the property in 1925, stated that the lowest point of the drift run from the incline was at an elevation of 1230 feet, or 50 feet below the adit portal.

A bar on the adjoining *Index* claim was worked through a raise from the Ethel adit.

Fouch Drift Prospect. Owners, F. Fouch, c/o J. A. Garland, Butte Meadows Stage; J. Fouch and W. M. Triplett. There are 160 acres in the claim.

This prospect is on the west side of ridge between Big Butte Creek and Chico Creek, in the Chico Creek drainage basin a few miles north of Forest Ranch. A rhyolite-capped channel has been prospected by adits started from a creek which crosses the channel. Going upstream, smooth, hard bedrock so far found has been reported unfavorable for a concentration of gold, though some pay has been taken out at intervals. The adits in both directions are short. There is thought to be over one-fourth mile of channel in the upstream section on the property and 500 feet downstream.

Genii Mining Company, C. N. Miller, president, Holbrook Building, San Francisco. The leases cover 485 acres in S½ Sec. 19, N½ Sec. 30, T. 23 N., R. 4 E., and E½ of NE¼ Sec. 25, T. 23 N., R. 3 E., lying one-half to 1½ miles north of Magalia and reached by private road from the Magalia-Stirling City road.

Work began in the summer of 1928 on a bedrock adit starting from the west bank of West Branch of Feather River in NE¼ Sec. 30, T. 23 N., R. 4 E., at an elevation of 1645 feet, and about 200 yards west of the Sawmill Peak trail. This adit was designed to reach and drain the Mammoth Channel and to permit cheap handling of the gravel. For 3000 feet it has a course N. 70° W., turning N. 25° W. in the last few hundred feet; it is about 3500 feet long and in serpentine and diorite until high gravel and sand are encountered near the bend. Here caving occurred and caused trouble and delay. This high gravel was barren or nearly so, and it was evident that the adit was too high to bottom the channel. An inclined winze 140 feet long giving a vertical depth of 50 feet below the main adit, was then sunk near the face and a hoist and bin were provided.

From the foot of the winze the channel has been explored for a length of about 300 feet downstream and 1000 feet upstream, part of the work being on the east rim. A total of about 2000 feet of work, including crosscuts run to determine the rims, has been done on this level, up to October 3, 1930. Both rims are shown and there seems to be no doubt that this is the Mammoth channel. It has a width of 200 feet or more in the workings. The gravel is largely of diorite, with very little quartz and occasionally a pebble of red jasper. At places flows of lava mud and cobbles are seen. The bedrock is diorite and serpentine. The gravel is tight or sufficiently cemented to stand well on bedrock. On the east rim in the south drift in a crevice at the contact, a seam of black gravel carries coarse gold and this crevice has yielded several

hundred dollars. The work here indicates a normal cross-section of channel on east, with finer gravel and a sand layer on the rim. On the west a crosscut of 500 feet is in bedrock entirely, with raises of 27 and 47 feet to rim gravel. From the face of this crosscut a diamond drill-hole was run 487 feet N. 55° W., all in bedrock.

The occurrence of hard reefs of bedrock crossing the course of channel has caused trouble in following bedrock. Holes occur on both sides of such a reef, and after crossing the reef, bedrock will be lost for some distance going upstream. One such reef necessitated a raise of 10 feet above the winze level. With such conditions, it is difficult to determine the average grade of the channel, but there is a total grade of 20 feet in a length of less than 600 feet between the lowest bedrock exposed downstream and that 300 feet upstream from the shaft. The Genii workings are about 6000 feet downstream from the Parry Incline. Lindgren stated the elevation of the supposed bedrock of the channel at the Parry Incline was 1630 feet.[1] A figure quoted by engineers familiar with the district is 1704 feet for the elevation of bedrock there. Using the latter figure would indicate a fall of about 84 feet from the Parry Incline to the Genii, assuming both workings to be on bedrock in the trough of the channel.

An occurrence which has saved the company the pumping of water is the natural sealing off of water from the lower stratum of gravel which is now being explored. In the main adit a flow of about 1½ cubic feet per second was tapped, but the winze workings are dry. Either at some place upstream, a layer of lava ash or mud, impervious to water, has closed down directly on the bedrock, or the upstream segment of channel has been faulted sufficiently to divert the water. The former possibility seems more likely under the circumstances. It could have happened where the stream had such a steep grade that it was swept clean of gravel, and the lava mud later swept down along the bare bedrock.

The work of washing gravel has been interrupted by the issuing of an injunction against the dumping of tailing in the West Branch of Feather River. Only five men were employed at the time of visit, pending the financing and construction of a washing and tailing storage plant. The grade of gravel washed has varied greatly, ranging from $1.50 to $30 a cubic yard.

The equipment includes air compressor with 75-h.p. electric motor, drill sharpener, blower, shop and camp buildings, underground hoist and storage battery locomotive which handles six cars per trip. The washing equipment, includes several hundred feet of flume.

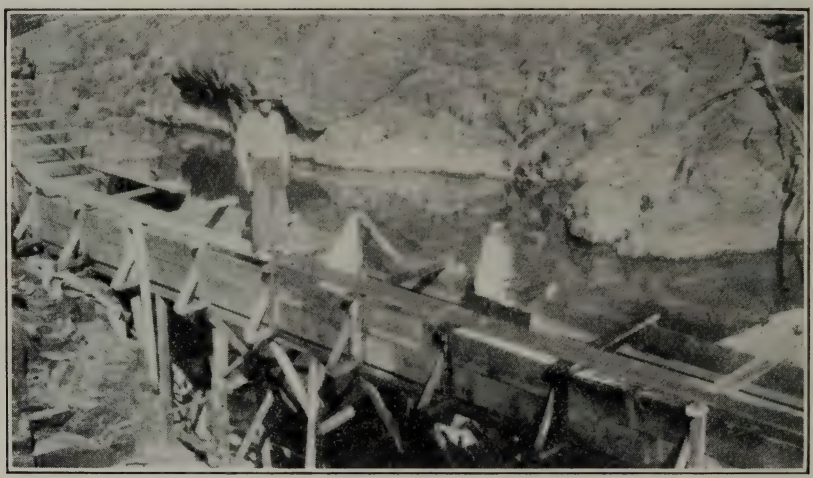
Hupp Placer property comprises 480 acres in NW¼ Sec. 1, N½ of SW¼ and N½ Sec. 2, T. 23 N., R. 3 E., a mile north and east of De Sabla. G. G. Hupp, De Sabla et al., owners.

The Indian Springs adit was run upstream on the channel for about 700 feet on the Hupp ground, when stopped by injunction. Another channel (see Nugget) was worked by a shaft 80 feet deep and an incline from it in NW¼ of NW¼ Sec. 1, but work had to be suspended on account of water, after a reported production of $9,000.

[1] Lindgren, W., U. S. Geol. Survey, P. P. 73, p. 92.

Indian Springs Drift Mine comprising 140 acres in Secs. 3 and 10, T. 23 N., R. 3 E., near De Sabla, was one of the profitably productive mines of the county. The last work was in 1920–1922 when Henry S. Porter had a lease on the property and E. F. Woodworth directed operations. The old working adit was repaired and was being advanced when the owner of the adjoining Hupp holdings sued for an injunction and work was stopped, after the adit is reported to have passed into the Hupp ground 700 feet, going upstream.

The old Indian Springs adit was started in 1860 and worked continuously for over 30 years, and finally reached a length said to be 6500 feet including turns, but showing 5200 feet long on a section. As described by E. B. Preston [1] the gravel breasts were 120 feet wide by 6 feet high and contained about 50 per cent cobbles and boulders. A shift's work for a miner was three carloads of gravel of 1500 pounds



Flume for diverting stream and pumps used to unwater deep holes at Jack Pot Mine, Butte County. Photo by J. J. Hartley.

each, which yielded $7 to $8 a carload then. The average for the mine as a whole was less.

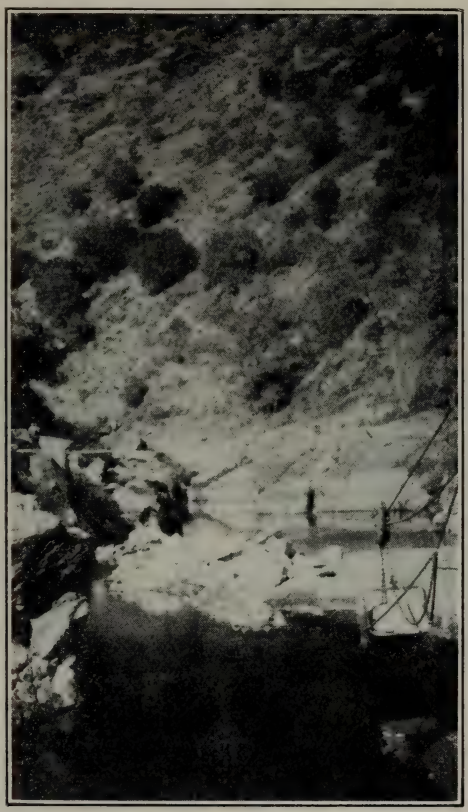
According to a map made at a later date than the above, there was a section of this channel about 750 feet long which was faulted down and where former work stopped. Work done under Woodworth passed through this faulted section, encountering a copious flow of water, which continued for five months. Pay gravel was reported, but obviously the expense of operation was high and the adit was expensive to keep open. A long section of this channel and its two supposed tributaries is believed to remain unworked on the adjoining properties.

Jackpot (Golden Pool) Mine is on West Branch of Feather River 8½ miles by road and trail from Paradise, just below the old Cape Horn Mine. It contains two unpatented claims along the present course of the river. Some work was done in 1927 by H. W. Furlong and A. C. Gardiner. In July, 1930, J. J. Hartley, W. A. Coffman and partners began work under lease.

[1] State Mineralogist's Report XI, p. 159.

The deposit consists of the gravel along the present river, which here occupies a steep canyon with deep holes in hard bedrock, and bars of gravel which have accumulated in the flatter sections. When visited in October, 1930, 8 men were working..

The river has been diverted by means of a concrete dam 18 feet high and 60 feet long, which turns the water into a 2-ft. by 4-ft. flume 762 feet long. A drag-line bucket of one-half cu. yd. capacity is used. Where scraping can not be done on account of the uneven, hard bedrock, hand shoveling into the bucket is resorted to. The bucket is operated



Drag-line scooper in operation at Jack Pot Mine, on west branch of Feather River, Butte County. Photo by J. J. Hartley.

over a span of 1⅛-inch cable, 550 feet long, delivering the gravel to a grizzley set over the flume. Power is furnished by two large automobile engines operating hoists with gear ratios arranged to give lifting power sufficient to handle boulders of several tons weight.

The flume is divided into two sections in the lower portion, a section 18 inches wide being used for washing gravel. It has a grade of 3 inches in 12 feet and is fitted with riffles for a distance of 132 feet.

When the claims were visited, a hole about 25 feet deep and 25 feet wide was being cleaned out in the hard, slaty bedrock of the river, and it was also planned to work the gravel bar below this hole. No clean-ups

had been made up to that time, so the gold content per yard was unknown.

Kelly Hill Mine contains 380 acres in the middle and western parts of Sec. 27 and in the SE¼ Sec. 28, T. 23 N., R. 3 E., two miles south of Nimshew at an elevation of 1000 to 1500 feet. *Gold Wedge Divide Mining Company,* lessee. Thomas V. Barton, superintendent, Chico, c/o De Sabla stage. The ground slopes west and south toward Big Butte Creek.

Four adits were driven by former operators and these workings have been extended by the present company. The adits were run north and northwest from the south slope, at different levels going in a northerly direction. In the search for payable gravel they have prospected an area nearly 1000 feet square. The main adit follows at first the direction of schistosity of the slate, toward the northwest, but several crosscuts have been run from it in a northeasterly direction, one of these crossing the strike of schistosity of slate for nearly 1000 feet. Little or no gold was found in these crosscuts outside of a zone about 200 feet wide. This zone runs northwest. In it, the gold occurred in coarse pieces at high places on the bedrock, but there is no defined paystreak which could be followed. Going east or northeast, the bedrock raises, although there are no definite rims. The slate is fluted or cut by gutters across the line of schistosity, and in such places is often fresh and unaltered. The gravel generally shows little or no shingling and is not assorted or stratified as might be expected in a channel deposit.

If a channel existed here it may have been cut out by later erosion, such as that caused when a stream trough is choked by lava ash and cobbles, resulting in the establishment of new drainage channels. Although the deposit is low enough in elevation to suggest the possibility of it being in an old delta, the evidence of this is not completely satisfactory in the main Kelly Hill workings. It is certainly near the old shore-line.

About one-half mile west of the above workings, above the road and where a side canyon has cut the gravel, there is a heavy bank of intervolcanic gravel. The part carrying fine flaky gold is from three to seven feet thick, containing greenstone cobbles mixed with lava mud and sand. It has a lava roof and lies on a floor of cemented cobbles. It apparently filled so rapidly that there was no time for stratification or shingling. This gravel is tight enough to require milling. An adit about 400 feet long has been run here and considerable of the gravel has been breasted and washed. This work was done by various operators, many of them prospectors working long enough to get 'grubstake,' so there is no record of the production.

At the main Kelly Hill adit there is a 20-h.p. semi-Diesel engine and an old air compressor. At the 'grubstake' workings there is a 15-h.p. engine and an 8 in. by 6 in. air compressor.

No work was being done in October, 1930.

Little Butte Prospect is on Little Butte Creek one mile north of the Steiffer Mine. There are 80 acres of unpatented claims covering quartz and placer prospects. The latter lie along the creek where some ground on a flat of several acres has been partly prospected. J. and O. Van

Ornum, John Smith and Jess Triplet, Box 38, Route 3, R. F. D., Chico, owners. One man was doing assessment work in June, 1928.

Lucky John Drift Mine. Enterprise Gold Mining Company, owner. A. J. Martens, president, 2902 Nineteenth street, San Francisco. It contains 360 acres of placer mining ground and 30.67 acres in recently located claims, in Secs. 2 and 11, T. 22 N., R. 3 E., two miles north of Paradise. Most of the work has been in the NW¼ of NW¼ of section 11.

The work done up to that time was described by the writer in the June, 1922, issue of MINING IN CALIFORNIA. The main working adit, running south and southeast, had reached a length of 566 feet then, and payable gravel had been opened near the face for a length of 100 feet, as well as at the top of a raise put up 45 feet vertically at a distance of 257 feet from the portal. Since then, the gravel opened

Lucky John Drift Mine, near Paradise, Butte County

in both these places has been worked a little. The gravel on the main level was breasted for a maximum width of 60 feet and some branching drifts were run east 70 feet and west and southwest as much as 110 feet from the main crosscut, showing a width of over 100 feet of gravel. The bedrock pitches south to S. 20° W. It is reported to have paid for two feet next the bedrock in the pay streak. In breasting upstream from the main level a U-shaped bend was made and a steep tributary or gutter was followed 385 feet north. This, called the Blue Raise Channel, raised 44 feet in 385. It was breasted 10 to 25 feet wide. The face is scarcely 80 feet from the face of an old adit.

The 'Red Channel' was struck first in the raise from the main adit 257 feet from the portal, and again in a raise driven 100 feet west up the steep west rim of the 'Blue Raise Channel' 330 feet north of the turn from main adit. It is 26 feet higher here than the 'Blue Raise Channel.' This upper gravel has been worked for a length of 105 feet southeast of the last raise, and 6 to 10 feet wide. It is older gravel

than that below, the gold is coated with a rusty covering and the east rim is flat. This run may be an early bench. A raise is being put up to tap it in the south workings. The west rim was not seen, but there seems to be little doubt of the channel character of the gravel, although the old beach line is close, on the Mineral Slide property. This gravel is loose and has a great deal of sand.

The bedrock of the mine workings is Calaveras (Carboniferous) and Mariposa (Jurassic) slate, striking northwest and dipping northeast. About 700 feet in the adit going north to prospect the main channel, the adit crosses a quartz stringer lead in Mariposa clay slate. This lead is 20 feet wide, and a little specimen ore is reported in it, at the crossing, but no further work has been done on it yet. An auriferous lode system, reported 60 feet wide, strikes northwest 500 feet ahead of the north face.

Equipment includes two 5000-gallon tanks, a 14,000-gallon reservoir, 150 feet of 12-inch sluice, gravel bin of 50 cars capacity, two screens, one-drill compressor and electric motors. Seven men were employed in June, 1928.

Work done in 1930 under the direction of W. J. Neale resulted in the production of several hundred cubic yard of gravel which paid costs of operation.

Lydia Placer Mine was profitably worked by Dave Campbell, owner, Coutolenc, until deprived of a cheap water supply. This claim is on the Nugget channel just upstream from the Nugget Mine. Campbell states that pay was found on the short side of bends on high bars, but that the main channel carried no pay. Ground sluicing and drifting were employed. The channel here was only about 20 feet below the surface. A length of 250 feet out of 750 feet of channel on the property has been worked.

Magalia Mine (*Perschbaker* or *Lucretia*) is in S½ Sec. 13 and in Sec. 24, T. 23 N., R. 3 E., one and one-half to three miles north of Magalia by road. Owner, Magalia Mining Company, 910 American National Bank Building, San Francisco.

The first discovery of the channel on this land was made in 1855 by Birch and Barrett on the bank of Little Butte Creek in the SW¼ of SE¼ Sec. 13, where rich gravel was found almost at the creek level alongside a massive quartz vein. They followed this channel downstream in a westerly direction and found it to be rich in gold, but they lost their title to the claim, which passed into the hands of Perschbaker. He continued the incline under the lava and downstream under great difficulty and at heavy expense. The channel was only from 4 feet to 20 feet wide and usually had only a meager amount of gravel, most of it subangular, but it was rich in coarse gold. The channel followed a winding course and had an irregular grade, varying from 3% to 12%. Gassaway [1] stated it had an average grade of 11%, but in a total distance of 3500 feet mined, it dropped 282 feet according to Lindgren. A steam plant of four 4-ft. by 16-ft. boilers was required to run the ten pumps needed to take water out of the workings. The water flow finally reached 35 miners inches.

This channel, called the Perschbaker, proved to be the east branch of another channel, which has been called the Little Magalia, to dis-

[1] A. D. Gassaway, formerly superintendent, Magalia Mining Company.

tinguish it from the Magalia or Mammoth channel, which is mentioned in the article on the Genii Mine (see, *ante*). While several people have expressed the opinion that the Little Magalia was a tributary of the Mammoth channel, none of the mine openings on the Magalia ridge have proved this, and the evidence now available indicates this is not the case. Therefore it seems better to use the name Mammoth channel for the large buried river which rose miles outside the Magalia district beyond Stirling City, and call the channel worked in the Perschbaker and Magalia mines the Magalia channel.

In 1890 the Perschbaker property was shut down and passed into the possession of N. D. Rideout and J. B. Haggin. Magalia Mining Company was formed and in 1894 a vertical shaft was started 45 feet ahead of the face of the old workings. This shaft was sunk 502 feet vertically through volcanic material, and a sump 10 feet deep was made in bedrock. Here was placed a pump capable of handling 500 g.p.m. of water under a lift of 500 feet.

After tapping the old workings June 14, 1896, and drawing off the water, mining began anew. The channel was followed downstream from the shaft 3950 feet, and upstream the west fork was mined for a length of nearly 2000 feet. In going downstream, the channel had an average grade of 6% for 1750 feet. Then a fault with an upward throw of five feet was struck. For the next 1450 feet, the grade averaged 4%. At the end of this distance, a second fault, with an upward throw of 38 feet on the downstream side, was encountered, and 250 feet farther a third fault was crossed which had an upthrow of six feet. The bedrock was composed of successive belts of serpentine, eruptive rocks, slate and 'porphyry.' The channel was 30 to 60 feet wide and pay extended five to six feet above bedrock, though mostly on or near bedrock.

The gravel at first was free, and was easy to wash, but soon became cemented and a mill of ten 850-lb. stamps was installed to work it. The duty per stamp was eight tons in 24 hours through steel wire screens with three-sixteenths inch mesh. Most of the gold was coarse and was saved in the mortars, nearly all the remainder being caught on the tables which were made of sugar pine planks with grooves two inches by one-half inch filled with quicksilver.[1]

The main working gangway was run down the center of the channel as nearly as possible, but because of the faults and variations in grade of bedrock, gravel and water had to be handled in several stages by different hoists and sets of pumps.

By December, 1899, the workings had reached as far downstream as it was thought practicable to go. The channel in a length of 3950 had dropped 186 feet so that water from the face had to be pumped nearly 700 feet vertically. Going upstream, the vicinity of the property line had been reached, and uncertainty existed as to the exact course of the channel beyond. A court order for an underground survey was obtained by Joe Campbell, then owner of land adjoining the mine on this side. The mine was allowed to fill with water at that time and has been idle since.

There have been many tales told of the richness of this channel and its branches, but exact figures are not available. From reliable statements it appears that the average yield of the channel during the

[1] Some details taken from a report by A. D. Gassaway, former superintendent.

Magalia Mining Company's operations between June, 1896 and December, 1899 was $150 per linear foot. Possibly the average return from the upper section of the Perschbaker branch was even higher; figures several times as high have been quoted, but we have no means of checking the authenticity of these. If the entire mine produced at the rate of $150 a linear foot the gross output was about $1,200,000.

Mammoth Magalia Mining Company. I. N. Dally, president, 602 Lloyd Building, Seattle, Washington. The land being prospected is in N½ of N½ and S½ of NW¼ Sec. 35, all of Sec. 26 and W½ Sec. 25, T. 23 N., R. 3 E., with adit rights in Sec. 34 and in Sec. 3, T. 22 N., R. 3 E. It is held under a sublease from *Magalia Treasure Box, Incorporated,* which holds the first lease from the owners. The Mammoth channel is being sought.

Some drilling has been done in NE¼ Sec. 34. An adit has been started in the NE¼ Sec. 3, T. 22 N., R. 3 E. at an elevation of about 1200 feet. This had reached a length of 180 feet in October. The total length of tunnel required is estimated by Dally to be about 4000 feet with a grade of one-half of one per cent. Work at present is being done by hand drilling.

The Mammoth channel has been prospected years ago in the Parry incline, two miles upstream and work at this time is going on at the Genii about a mile upstream where a washing plant is to be installed to handle the gravel. The work at the Genii will give the first real test of the value of the gravel in this channel above the Mammoth Magalia holdings. Downstream, not far below this ground, several tunnels and shafts were driven in search of the Mammoth channel. None of these was successful in developing pay gravel. It is not known therefore if this channel will pay to work by drift mining, though the possibilities of this have appeared so attractive that it has long been a subject of investigations and reports. Conditions seem to favor development here more than in other sections along the channel.

Besides the length of over a mile of the Mammoth channel which the promoters believe lies within the boundaries of this lease, it appears possible that the Magalia channel crosses the property for a distance of one-half to one mile. The lowest workings downstream on this channel in the Magalia mine were one-fourth mile or more north of the north line of the Mammoth Magalia lease. This channel paid a gross return of $150 a running foot, and varied in width from 30 to 60 feet. Whether or not the remaining downstream section of the Magalia channel could be worked at an ultimate profit from the present Mammoth Magalia tunnel depends on the direction of the Magalia channel and also on whether or not it is a tributary of the Mammoth channel, both of which are unknown factors.

Mineral Slide Gold Mining Company's property contains 390 acres in N½ Sec. 10 and S½ of Sec. 3, T. 22 N., R. 3 E., three miles southeast of Magalia.

The holdings face on Little Butte Creek canyon for a length of a mile and extend south one-half mile. It has been worked intermittently for a long time, during which ten adits have been run, as follows:

No. 1, run 1200 feet a little south of east from Van Fossen Ravine, is partly caved. It started 575 feet northeast of the west ¼ section corner, going from bedrock into gravel.

No. 2, 300 feet long, all caved, showed gravel with a prospect of gold at the face, but it was too high. It started near the north ¼ section corner between sections 10 and 3.

No. 3 was run south then east, over 500 feet, passed through some old works and showed gravel 80 feet wide running $1.50 a cubic yard.

No. 4 is about 200 feet east of No. 3, and is 170 feet long with a raise of 10 feet to gravel in which it continued 127 feet. This paid well.

No. 5 adit paid well. It showed gravel and bedrock dipping south and west.

No. 6 is an early day adit, too high and caved. Adits 4, 5 and 6 are, in order, 200 to 250 feet apart and east of No. 3.

No. 7 is a double track tunnel 1260 feet long running southeast and connecting by a raise of 36 feet with No. 8, an incline running southwest 1200 feet. From the connection the incline was continued 400 feet. From these workings a large amount of gravel yielding from $1 to $10 or more a yard was mined. This was in part cemented or tight, and was washed four times, each washing yielding part of the gold, the total amount having averaged $3 a cubic yard. Workings are caved.

No. 9 adit was started on the Lucky John property just east of the east line of the Mineral Slide, but entering the latter property almost at the southeast corner, then passing back into the Lucky John. This adit, now caved, is said to have shown pay gravel near the face. This is undoubtedly the same channel since developed a little farther east in the Lucky John Mine (which see).

No. 10 adit, started about midway of the property near the north line, between No. 2 and 3 adits, was run 1200 feet or more south, with the intention of extending it to the south property line and furnishing drainage and a working entry from which the property could be worked to advantage. It was to be on sluice grade of 5% to permit washing in boxes from the face. It was not completed and the property has lain idle 12 years or more.

The Mineral Slide property lies along a part of the Ione shoreline, the gravels lying partly on slate and partly on Cretaceous sandstone.[1] The sandstone below the gravel has yielded Chico (upper Cretaceous) marine fossils. The bedrock of the gravel sinks rapidly on this property from an elevation of 1500 feet on the north to about 1000 feet on the west, and there is an immense deposit of low grade gravel. On the rims and possibly also along gutters in this deposit, the good pay was found. The Lucky John Mine, immediately east, shows a defined channel on slate bedrock in their northerly workings without the evidence of marine action.

Mountain House Drift Prospect contains 20 acres in the center of Sec. 4, T. 21 N., R. 6 E., three-fourths mile from Mountain House on the creek of the same name. August Amend, owner, Berry Creek, c/o Mountain House.

This covers an old back channel of the creek, buried by an ancient landslide. It was drifted by former owners for 250 feet, when the workings were lost on account of water and running ground. It was reported to be rich. There is a distance of 1100 feet believed to remain

[1] U. S. Geol. Survey Annual Report XVII, Pt, 1, p. 545.

unworked on the claim between the points where the present stream cuts the old channel.

The present owner has been working alone for several years, aiming to strike the channel with a bedrock adit which will drain the ground. The exact course of the old stream under the slide is uncertain and previous adits, including one 350 feet long, did not reach the objective, but the present working, now 200 feet long, is believed to be under the gravel, which will be tapped by a raise.

The *Nugget Drift Mine*, in S½ Sec. 36, T. 24 N., R. 3 E., was opened on the Nugget channel at Toadtown, and worked downstream at a profit for 200 to 300 feet. The present upper course of Little Butte Creek crosses this channel at Toadtown. The gravel carried pay distributed over a width of 60 feet. Mrs. Julius Smith, owner, Chico.

This channel passes downstream into the Hupp property, where a shaft and incline were sunk on it. Upstream, it enters the *Lydia* mine and passes from there into the *W. H. Walker* claim. This is locally considered as being probably a branch of either the Perschbaker or Indian Springs channels.

Oro Fino Mine. Robbers Roost Mining Company, W. F. Anderson, general manager, 903 Hobart Building, San Francisco. The company owns 360 acres in Secs. 10 and 11, T. 23 N., R. 3 E., just west of De Sabla, and has a lease and option on other land adjoining. Nat Lambert, superintendent.

The old Robbers Roost workings are in section 10, midway between the Emma and present Oro Fino workings. The Robbers Roost adit was about 2500 feet long with 1500 feet in length breasted; a small channel now being worked was also found there.

The total distance from the portal to face of main Oro Fino adit is 5800 feet. Present work is carried on through an incline shaft with a vertical depth of 125 feet, striking this adit 1300 feet from portal and at an elevation of 2250 feet. The old workings of the Oro Fino are described in past reports of the State Mining Bureau, in which the width of pay gravel in the main run was given as 40 to 50 feet. The grade was steep and the pay is said to have been mostly on the serpentine bedrock. A small branch was struck 750 feet in and was worked; in a length of 225 feet, it rose 70 feet. The gravel in 1888 was said to pay $5 per 1800-pound car or $40 per shift per man.[1] In 1892, it was said [2] to pay $100 per man. In 1896 the main adit was 2700 feet long. Evidently the bulk of production was made by those former operators. The present company has had the mine 15 years, but has not made much production as they have been running mostly through old ground and bedrock, in search of the Emma channel.

The present main adit, which runs southeast and east, raises 110 feet in a distance of 3000 feet from the foot of shaft to junction with a small branch channel entering from the northeast. The main adit has been run about 1500 feet beyond this. Two faults with downthrows of nine and seven feet on the east side were crossed. At the face, they struck a third fault, also with downthrow on the east side. They have

[1] State Mineralogist's Report VIII, p. 118.
[2] State Mineralogist's Report XI, pp. 160–161.

been sinking an incline here, which was 56 feet deep vertically early in June. Lambert thinks these are the same faults found in the Indian Springs Mine, three-fourths mile northwest, and expects to sink about 25 feet deeper before reaching the level where he can continue crosscutting. Work here had been suspended while awaiting a pump. Five men were running a drift upstream on the branch channel last mentioned. This had been followed at time of visit (June 14, 1928) for 500 feet and had raised 40 feet. It runs on serpentine bedrock, carrying black and rust-stained gold. The pay is 4 to 12 feet wide. Coarse, rough crystallized gold in subangular quartz is common. The face seen was in coarse sand, with from a few inches to one foot of gravel next the bedrock.

A line of 12-inch sluice boxes with riffles traverses the entire length of the workings nearly to the working face. Water is brought into the mine in a pipe line (8-inch outside diameter) from a reservoir below De Sabla, giving a pressure head of 326 feet at the working face. The face is bored with augers and after blasting with light charges the gravel and sand are washed with a hose into the sluices. The gold lodges on the bedrock and in the first few boxes, and tailings are carried out the adit. This is a cheap and rapid method of working, which has been adopted in some mines in this county where channels are steep enough to permit tunnels on a sluicing grade.

Electric power is available for pumping and lighting and a blower operated by water power was used for ventilation. This mine was idle in 1930.

Pitts Mine (Old Bader, or Mowry & Newman). It is in sections 1 and 2, T. 22 N., R. 3 E., a mile and a half from Magalia by road and trail. Owners, Mowry and Newman, San Francisco. Lessee, *Lillian Mining Co.*, Maurice Reich, president, 125 Geary Street, San Francisco.

The lessee has been prospecting the property since December, 1920. The work done up to June, 1922, was described in the report of the State Mineralogist for 1922, pages 260 and 261. The claims had been previously worked by hydraulicking and by a series of adits and are said to have made a production variously stated at from $75,000 to $200,000, but no definite records were shown to substantiate this. Since 1920 there has been little production.

Geological conditions here are mainly similar to those observed in the Bader Mine (which see). The same channel has been prospected. No. 1 adit, started at an elevation of 1785 feet (aneroid), is about 2400 feet long. Above it and to the south, raises and drifts have been run. The Reich raise reached a point nearly 70 feet higher than the portal on the east rim of the channel. The Pitts drift was run from the top of a raise from the main entry level, southward 200 feet. Another drift reached a point 300 feet south, where considerable water was struck. Here there is a lava-filled cut in the bedrock of the east rim, suggesting interesting geological possibilities in that direction. The present lower workings are not low enough to properly bottom the ground downstream.

From time to time, patches of payable gravel, containing one or two carloads each, have been found but the operators have not solved the problem of locating any definite pay streak, if such exists. The pay

probably occurs in small streaks or gutters; the gold is coarse and coated black. The channel is not so well defined here as at the Bader Mine, as here it is much nearer the ancient shore-line.

There is a gas engine, blower and air-drill equipment on the claims, but recent work has been by hand, with three or four men employed.

A quartz vein 2 to 5 feet wide crosses the north end of the property. In 1929 a stamp-mill was erected and some mill-runs were made on quartz from this vein, but it was found to be too low grade to pay a profit.

Since then work has been resumed to prospect the gravel, and was going on in October, 1930. Some payable gravel was being washed from a winze near the face of the adit, but no definite pay-streak had yet been found.

Princess Mine. George A. Ducharme, owner, Detroit, Michigan. *Cory Mine Company, Limited,* lessee, 381 Bush Street, San Francisco. E. A. Duer, president. Joe Wright, superintendent. The holdings comprise about 320 acres in NE¼ Sec. 13 and SE¼ Sec. 12, T. 23 N., R. 3 E.

Two holes were drilled on the southern part of the NE¼ of Sec. 13. One of these reached a depth of 515 feet. For a depth of 362 feet, this was entirely in lava and lava sand, according to the company's log of the hole. Below there, small amounts of water-washed rocks and sand, lava, and lava sand occurred, followed by clay and the first gold colors were reported at 471 to 485 feet. From 485 to 495 feet, water-washed gravel carrying gold was claimed, the hole passing into solid serpentine at 511 feet.

A vertical shaft 4½ feet by 9 feet in cross section is being sunk beside this drill-hole. On October 2, 1930, this shaft was 212 feet deep and at the present rate will reach bedrock in about six months, working two shifts. So far no pump has been required as the drill-hole has served as a drain. This shaft is 350 feet north of the Magalia Mine property-line.

A 55-h.p. tractor engine furnishes power for hoisting and for running a 12- by 10-inch air compressor. Timbers for mine use and lumber for buildings is supplied under contract by a sawmill on the property. A small gasoline engine runs a blower for ventilation.

The old Princess inclined shaft is about one-half mile north. It was 330 feet deep on an incline of 32° and has been supposed to be on the upstream extension of the Magalia mine channel or on a branch of it.

Robison Drift Prospect is in Sec. 15, T. 24 N., R. 3 E., about three miles by road and trail from Berdan. W. A. Robison, Chico, c/o Forest Ranch, is in charge of prospecting, with a few men employed.

Royal Drift Mining Company prospected the property, working three shifts for several months, but gave up their lease. This prospect was not visited. Workings are reported to include an adit about 1200 feet long, which was 25 feet too high to bottom the channel, necessitating an incline, through which the later of the two channels described under the Dix Mine was prospected, and search is being made for the other.

Rotten Boulder Drift Mine is in the NW¼ Sec. 29, T. 22 N., R. 4 E., six miles from old Yankee Hill by Jordan Hill road and trail, on the east side of West Branch of Feather River. Knox Brothers, owners,

Magalia, have been working the property and had run an adit nearly north 450 feet up to July, 1928, at an elevation of 1425 feet (aneroid). This follows a steep channel in a narrow winding trench with numerous large, hard boulders. The stream evidently followed a soft seam in a belt of schist or a dike; the face is entirely in bedrock or rotten granitic rock. The owners reported a small production during 1928.

Equipment includes a tractor, gasoline engine and vertical compressor. The Blue Hog Mine workings, perhaps on the same channel, but downstream and on the opposite side of the river, bear S. 70° W., about one-half mile and 175 to 200 feet lower.

Royal Drift Mining Company. R. M. Butler, Napa, California, president; Forest Snow, superintendent. The holdings cover nearly 800 acres for three miles along the lava-covered ridge west of Big Butte Creek in Secs. 27 et al., T. 24 N. R. 3 E., 23 miles from Chico via Forest Ranch, or eight miles by road and trail from Magalia. Present work is in the SW¼ Sec. 27, at 2350 feet elevation (aneroid).

The property, once called the Best Mine, was opened in 1879 by Best and Garland and they are thought to have produced about $35,000. The *Napa and Solano Mining Company* worked between 1890 and 1900 in the same adit now being used. They raised 30 feet above this when 650 feet in, and breasted a reported length of about 600 feet, for a width of 50 to 100 feet and a height of 5 to 6 feet. The present company has been in existence 20 years. Besides the work here, they ran an adit 1400 feet long in section 34, an adit 3000 and an incline 900 feet in Sec. 4, T. 23 N., R. 3 E. They have extended their present adit 2500 feet.

This main adit, starting in a westerly direction, branches 1500 feet in. One branch has been driven N. 8° W., 35 feet to a raise 12 feet high, from the top of which a crosscut was being run S. 45° W., to prospect a section of an early run of the Best channel, of which Snow thinks there may be as much as 3000 feet remaining. This work was 200 feet in, and was still in bedrock, when visited.

From the fork, the main adit continues 1900 feet N. 64° W., where a fault was encountered; an incline was sunk 300 feet (90 feet vertically) but had not reached the opposite side of fault when the incline was lost, and a sudden flow of about 20 miners' inches of water filled it. This water still flows, only partly reduced in volume, and is used for washing gravel. As usual in this region, the low side of fault is on the upstream side. This channel is locally believed to be the Dix channel, not yet bottomed on this property. The amount of faulting is uncertain, but may be 175 feet.

At a point 1300 feet from adit portal, a crosscut was run 40 feet and an incline was run 300 feet (25 feet vertically) down the bed of a late run; a crosscut thence northwest 100 feet struck an older channel on nearly the same level. It was followed upstream 100 feet and about 200 cubic yards of gravel that paid $5 a yard in coarse gold was mined, when the channel steepened and work was stopped.

Four men were working underground, and several on the surface. A 25-h.p. semi-Diesel engine drives an 8½″ by 12″ air compressor, and a 7-h.p. engine runs an air blower. A McCormick gravel mill is used to wash gravel which is tight.

Steiffer Mine (formerly Joe S. Campbell P. M.). P. B. Steiffer Mining Company, owner, North Ivy Street, Chico. The mine is in Sec. 13, T. 23 N., R. 3 E., and contains 80 acres; members of the Steiffer family control it as well as mineral rights on SW¼ Sec. 12, (105 acres), SW¼ Sec. 1 (140 acres) and W½ of NW¼ Sec. 12 (70 acres).

The Steiffer shaft in E½ of NW¼ Sec. 13, was sunk vertically 334 feet and an incline was started at a point 20 feet north of the bottom of shaft, and was sunk toward the west on an angle of 45°. At 50 and 100 feet, layers of barren gravel were cut. At 100 feet they struck the contact between lava and bedrock, where the angle of incline was changed to 15°, it was sunk 250 feet farther, and pay gravel was found on serpentine bedrock at a vertical depth of 508 feet from the portal, or at an elevation of about 2070 feet. A flow of 580 to 600 gallons of water per minute had to be pumped. The channel was crossed to west rim, a distance of 60 feet. A drift was run downstream 40 feet. A drift was started north and a crosscut was run west 200 feet in serpentine bedrock all the way, in search of another channel, but nothing was found. The main drift north in the center of the channel was run about 170 feet, and is claimed to have been in gravel carrying gold. The company worked intermittently until 1917, but the total length worked up to 1914 was only 250 feet. Great difficulty was experienced in keeping the mine pumped out, due to amount of water and to litigation which interrupted operation as well as a number of accidents which cut off the electric power used for pumping. Two hydroelectric power plants were built on the West Branch, but for many years little mining was done.

In 1921 the *Evening Star Mining Company* unwatered the mine again and did some work but quit in financial difficulties without paying the men. The workings were again under water shortly after they quit, and have remained so since. One of the men then employed there stated that the upstream face was about 900 feet upstream from the face of the old Magalia drift, which is supposed to be about 200 feet from the Steiffer shaft. The former employees were given an opportunity to work gravel then exposed, to obtain wages due them. One of these men stated in 1922 that they had a breast of gravel 20 feet wide by 7 feet high worth $13 a cubic yard in place, but could not make it pay due to the number of men needed for surface work, hoisting, etc., with only four or five at the face. Two hoists had to be operated.

Underground equipment during the Steiffer regime included 10 centrifugal pumps of 700 gallons per minute capacity, one of 1000 gallons per minute and 2 steam pumps of 600 gallons per minute capacity. The hydroelectric power plant on the West Branch had a rated capacity of 700-h.p., but the water supply was not always enough to run it. The transmission line has been stripped of wire. Other equipment now at the shaft, in buildings, which are in poor repair, includes 3 boilers, 10″ by 12″ compressor, double hoisting equipment (steam and electric) and an old style 52-h.p. motor.

The Steiffer workings are claimed by the owners to be on the upstream extension of the Little Magalia channel, which was worked up near to the property line previous to 1899.

GOLD DREDGING

Shasta-Butte Gold Dredging Company. Main office 614 Financial Center Building, San Francisco, has been operating the only dredger active in the county since 1928.

They put a small dredger in commission late in 1928 near Haselbusch, south of Oroville. This was one of the principal producers of gold in Butte County in 1929.

IRON

Prospects of iron ore found in Butte County have been mostly in the form of float. The following were mentioned in Bulletin 38: Sec. 5, T. 25 N., R. 4 E., at an altitude of 6000 feet, float. Secs. 7 and 27, T. 23 N., R. 4 E., float. Sec. 30, T. 25 N., R. 5 E., heavy iron float. Secs. 5 and 8, T. 25 N., R. 4 E., old locations.

A vein in Sec. 3, T. 22 N., R. 3 E., in serpentine bedrock is said to carry 60% iron, 5% to 8% manganese and a trace of chromite.

LIMESTONE AND MARBLE

Small bodies of limestone and marble occur in the eastern half of the county where the bedrock formations are exposed, as near Pulga and Intake; and between Pentz and Yankee Hill, where some quarrying and burning of limestone was carried on 25 to 35 years ago.[1] The last recorded production was in 1903.

Other properties mentioned in our Bulletin 38, page 98, are noted below. Several are too far from railroad to be utilized except locally.

Big Bend Marble Quarry in Sec. 32, T. 22 N., R. 5 E., described as showing a ledge of blue limestone, and another of white marble. It is near Intake on Western Pacific Railway.

Marble Creek Deposit in Sec. 10, T. 22 N., R. 6 E., a "heavy cropping of white marble." This is a little east of Merrimac. A logging railroad passes within two miles of several small lenses of limestone which occur almost on the county line.

Mooretown Marble is in Sec. 24, T. 20 N., R. 6 E., two miles southeast of Mooretown. Described as a "ledge of white marble."

Pentz Marble is in NW¼ Sec. 8, T. 21 N., R. 4 E., about five miles northeast of Pentz. The ledge is said to extend for a mile northwest through the center of this section. Some lime was burned here many years ago.

Poe Limestone Deposit is on the Western Pacific Railway line near Poe, four miles south of Pulga, in Sec. 18, T. 22 N., R. 5 E. In January, 1929, W. H. King, Pulga, owner of the deposit, made a contract with J. A. Levensaler, San Francisco, for the mining and shipment of the limestone to San Francisco. The stone can be cheaply handled as it is partly just above the railroad tracks.

Other bodies of limestone have been noted in Secs. 7, 17, 18 and 20, T. 21 N., R. 4 E.

[1] State Mineralogist's Report XI, p. 157.

MANGANESE [1]

Bear Canyon Mine. George W. Wooley, owner, Clipper Mills. In Sec. 35, T. 20 N., R. 7 E., one-half mile northwest of Clipper Mills. An orebody of manganese oxide containing 40% ore, produced 220 tons when worked in 1916 by Noble Electric Steel Company. Idle now. The property is 32 miles from Oroville, nearest railroad point.

Powell Prospect. E. V. Powell, Clipper Mills, last known owner. It is in Sec. 35, T. 20 N., R. 7 E., one mile north of Clipper Mills. A siliceous, manganese-bearing ledge was reported in 1917.

View Point Prospect, owned by E. C. Binet, Clipper Mills, is in SE¼ Sec. 34 and SW¼ Sec. 35, T. 20 N., R. 7 E., three-fourths mile northwest of Clipper Mills. Only a little shallow work has been done, showing prospects of siliceous manganese ore.

Jack Johnson, Magalia, found manganese ore in the county and listed same in *Monthly Commercial Mineral Notes* in 1928. Though many inquiries were made and samples submitted to those interested, it is said these proved too siliceous. In Johnson's absence, his associate refused information as to the location of the prospect.

MINERAL PAINT

Chico Ocher and Mineral Paint Company. Owners, Mrs. Frank Henshaw and Hochheimer and Company, Willows. An ocher deposit occurs on 360 acres of land in Secs. 5 and 6, T. 23 N., R. 4 E., near the Doon road and a mile from the Southern Pacific Railroad.

There was some production previous to 1900. The deposit was worked through an adit 200 feet long and a small open cut.

MINERAL SPRINGS

Mineral springs of the county are described and analyses of their waters are given in Water Supply Paper 338, U. S. Geological Survey.

Mt. Ida Spring is six miles east of Oroville. It supplies a carbonated water which has been used locally and has also been bottled.

Richardson Springs are in the canyon of Mud Creek ten miles northeast of Chico. There are four principal springs and a smaller one. They are classified as saline springs, some of concentrated character. One spring in particular carries considerable sodium, a moderate amount of potassium and calcium, and marked amounts of the chloride and sulphate radicals.

A popular and successful resort has been built up around these springs, with hotel accommodations for the large numbers who use the water for medicinal purposes. Water is also bottled. *Natural gas* from one of the springs is trapped and utilized in the hotel.

PLATINUM GROUP METALS

Platinum, iridium and other members of this family of metals, were recovered to the amount of 100 ounces or more annually when gold

[1] Cal. State Min. Bur. Bull. 76, pp. 30–31.

dredging was in full blast, but in later years this has dwindled to only a few ounces a year.

The platinum metals taken on the dredgers occurred in small, thin flakes carrying 68% to 72% platinum and about 20% osmiridium. These metals have also been noticed at some of the drift mines, and there has been a small output from the surface placers and river bars on the upper course of Feather River.

Bibl: Cal. State Min. Bur. Bull. 85.

SILVER AND LEAD

Bonanza King Prospect. Owner, John Wells, Yankee Hill. In May, 1928, an option was held by Lloyd Root, San Francisco. This prospect of four claims is in Sec. 16, T. 25 N., R. 5 E., about six miles east of Chaparral at a reported elevation of 6000 feet.

Wells has done assessment work for several years, in the course of which a prospect shaft reached a depth of 24 feet and a few small shipments of a ton or less each of sorted ore were made. This came from a streak reported about 16 inches wide in a wide vein. The property was not visited. Some prospecting was done by the lessee in 1928 and 1929, but in November, 1930, the claims were idle.

A shipment of 2230 pounds in 1924 gave 0.57 oz. gold, 112.58 oz. silver, 4.65% copper, 53.4% silica, 1.8% iron and 2.6% alumina (Kennett smelter). Another lot of 1720 pounds shipped in November, 1927, carried 0.71 oz. gold, 96.65 oz. silver, 8% lead, 3.4% copper, 6.4% zinc, 2.1% antimony, 0.1% arsenic, 2.7% iron, 61.6% insoluble. After all charges and deductions, the net return on the latter lot was $39.68 (Selby smelter).

Stirling City, the nearest railroad point, is 20 miles distant. The mine is connected by a steep trail with road.

The ores of a few other prospects in the northeastern part of the county carry lead and silver.

STONE INDUSTRY

There are three plants in the county which produce crushed rock, sand and gravel from the piles of dredger tailings near Oroville and Chico. The supply of such material is immense.

Bechtel-Kaiser Rock Company. Main office 1522 Latham Square Building, Oakland. T. M. Price, general manager, R. J. Kennedy, plant superintendent. Land holdings comprise 1000 acres at the southwest limits of Oroville, being ground that was worked by gold dredgers and was left covered by piles of cobbles and gravel.

The company makes a specialty of the production of No. 1 ballast for railroad use. This is 100% crushed rock, from three-fourths inch to 2½ inches. Secondary ballast, road material (mostly one-eighth inch to three-eighths inch), oil plant mix (one-eighth inch to dust) and rock from three-fourths inch down for other uses are made as by-products.

Standard gauge railroad tracks are run out as the work progresses. Rock is loaded with a steam shovel, with a 2¼-cubic yard bucket into air-dump cars of 12-cubic yard capacity and hauled to the plant by 40-ton steam locomotives. Cars dump on a grizzley, through which

most of the rock passes to a hopper and is fed by a Bodinson feeder to a 36-inch belt conveyor on 250 ft. centers. This discharges to a scalping screen 84 inches long. The inside screen sends rock 2½ to 3 inches in size to a 4-ft. Symonds crusher; 1½ inch gravel through the jacket goes to a stacker and material over three inches up to 12 inches goes to a 7-ft. Symonds crusher. The crusher discharges to a 30-inch belt conveyor, which delivers to a 5-ft. finishing screen. Rock between three-fourths inch and 2½ inches, forming No. 1 ballast, is sent on a 24-inch conveyor to a 5-ft. revolving screen for final washing. Oversize from the finishing screen is returned to the crusher over the main belt. Uncrushed gravel under 1½ inches, and crushed rock under three-fourths inch is put in stockpiles and is crushed, washed and screened as ordered. A Brownhoist crane on a railroad mount uses a clamshell bucket for handling products. Ballast is loaded by gravity from a bin to cars on the spur track serving the plant.

Plant of Coast Rock and Gravel Company at Oroville.

When running at capacity, the plant can handle 2300 tons in eight hours. From this 1200 to 1300 tons of ballast, 800 tons of gravel and 200 to 300 tons of crushed rock from three-fourths inch to dust, would ordinarily be obtained. A full crew consists of 32 men. Demand for the products is seasonal and the plant was idle in November, 1930, though it was active during most of the year.

Coast Rock and Gravel Company. Main office Hunter-Dulin Building, San Francisco. The Oroville plant is within the city limits. It belongs to Natomas Company of California and is operated under lease. H. W. Thorne, superintendent.

This plant has a daily capacity of 1000 tons of crushed rock and 1000 tons of gravel. Crushed rock is produced in standard sizes from 2½-inch to dust, gravel ¼″ by 2″, ¼″ by 1″ and pea gravel, besides which special sizes can be supplied.

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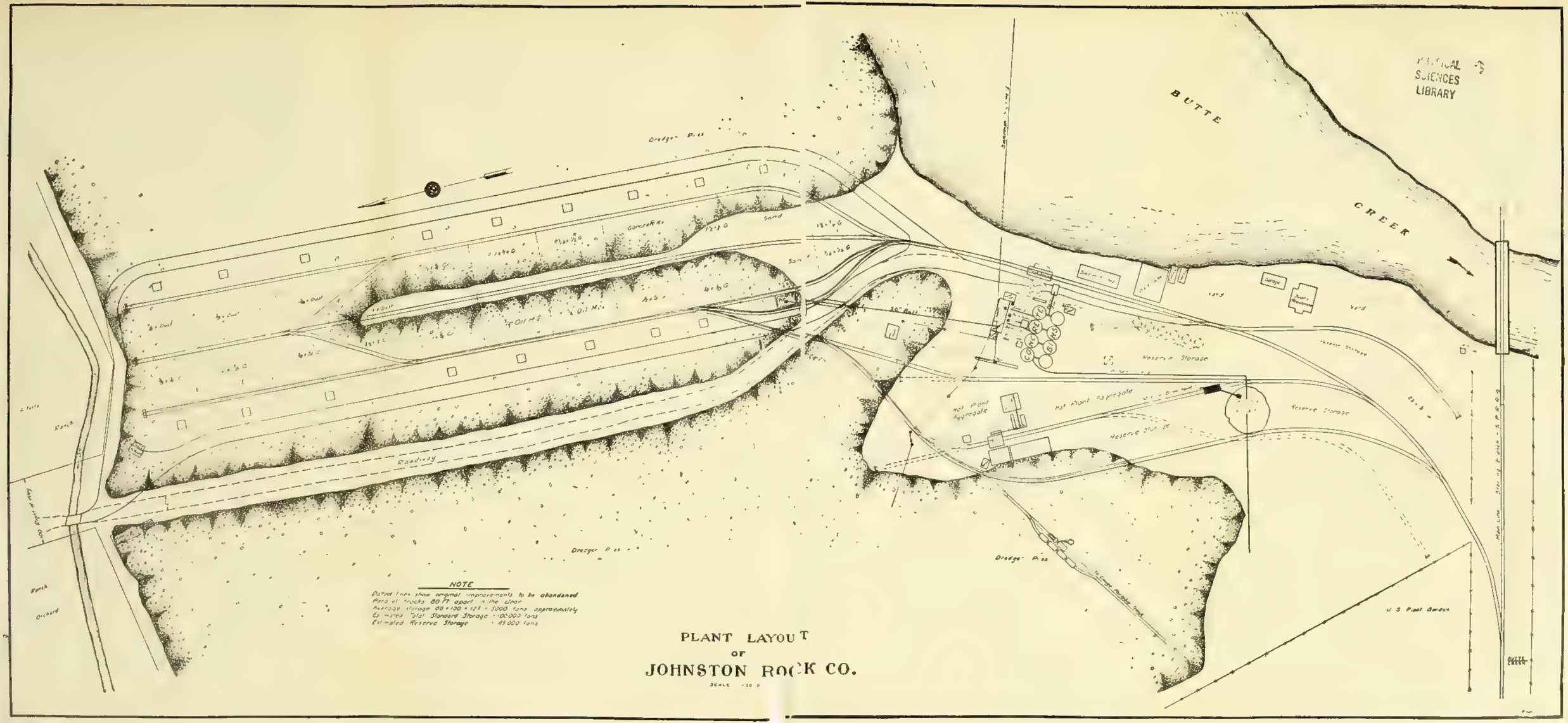
most of the rock passes to a hopper and is fed by a Bodinson feeder to a 36-inch belt conveyor on 250 ft. centers. This discharges to a scalping screen 84 inches long. The inside screen sends rock 2½ to 3 inches in size to a 4-ft. Symonds crusher; 1½ inch gravel through the jacket goes to a stacker and material over three inches up to 12 inches goes to a 7-ft. Symonds crusher. The crusher discharges to a 30-inch belt conveyor, which delivers to a 5-ft. finishing screen. Rock between three-fourths inch and 2½ inches, forming No. 1 ballast, is sent on a 24-inch conveyor to a 5-ft. revolving screen for final washing. Oversize from the finishing screen is returned to the crusher over the main belt. Uncrushed gravel under 1½ inches, and crushed rock under three-fourths inch is put in stockpiles and is crushed, washed and screened as ordered. A Brownhoist crane on a railroad mount uses a clamshell bucket for handling products. Ballast is loaded by gravity from a bin to cars on the spur track serving the plant.

Plant of Coast Rock and Gravel Company at Oroville.

When running at capacity, the plant can handle 2300 tons in eight hours. From this 1200 to 1300 tons of ballast, 800 tons of gravel and 200 to 300 tons of crushed rock from three-fourths inch to dust, would ordinarily be obtained. A full crew consists of 32 men. Demand for the products is seasonal and the plant was idle in November, 1930, though it was active during most of the year.

Coast Rock and Gravel Company. Main office Hunter-Dulin Building, San Francisco. The Oroville plant is within the city limits. It belongs to Natomas Company of California and is operated under lease. H. W. Thorne, superintendent.

This plant has a daily capacity of 1000 tons of crushed rock and 1000 tons of gravel. Crushed rock is produced in standard sizes from 2½-inch to dust, gravel ¼″ by 2″, ¼″ by 1″ and pea gravel, besides which special sizes can be supplied.



PLANT LAYOUT
OF
JOHNSTON ROCK CO.

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Rock is loaded by steam shovel and hauled a mile and a half in 6-yard and 12-yard cars by gasoline locomotives. The scalping screen separates rock for the crushers, of which there are one 36″ by 24″, one 36″ by 18″ and two 36″ by 10″. The larger rocks go to the first of these, while that from two to four inches goes to the 36″ by 10″ crushers, and minus 2-inch gravel goes direct to the washing screen. Rock and gravel is stored in bins and stockpiles. There are spur tracks from both the Western Pacific and Sacramento Northern Railways. Thirty-five men are employed. The plant was temporarily idle the latter part of November, 1930.

Johnston Rock Company, Box 523, Chico. J. E. Johnston, owner. The plant is a short distance from Chico on Butte Creek.

The old plant, which has been in operation since 1928, had a capacity of 1000 tons daily, using a Sauermann dragline rig. A new plant, for which the lay-out is shown herewith, is being built. It will have a capacity of 1500 tons a day. Sand, gravel, crushed rock, and 'oil mix' are produced.

Cobbles, gravel and sand from the old dredger piles which furnish the material, will be delivered to a concrete pit where a grizzley with 12-inch spaces will reject oversize and everything else will pass onto a 30-inch belt conveyor 310 feet long which will deliver to a scalping screen 28 feet long. This will separate sand and various sizes of gravel from pea gravel to 2½-inch. The oversize will pass to Symonds and Blake crushers and to revolving and vibrating screens, the crushed rock products ranging up to 2½ inch size. Besides bunker storage, stockpiles are maintained, a Brownhoist crane being used for this and for loading railroad cars.

The asphalt plant has a capacity of 450 tons a day of 'oil mix.' Crushed rock in sizes from dust to three-fourths inch passes by gravity from a bin to an oil-fired dryer 20 feet long, and after drying the rock is raised by bucket elevator to four bunkers. Oil is heated to 175° to 200° F., just hot enough to pump. Charges of oil and rock are drawn, weighed and mixed by paddles, then discharged to railroad cars below.

The plant is served by the Stirling City branch of the Southern Pacific Railroad. Fourteen men are employed.

TALC AND SOAPSTONE

These are widely distributed in those parts of the county where the bedrock formations are exposed, but many of the deposits are a considerable distance from railroad and are undeveloped. Soapstone is a common mineral in the state and in other counties deposits near railroad have supplied the demand, with consumers in a position where they can choose from a number of available sources of supply at a low price.

Soapstone occurs in the vicinity of serpentine dikes and amphibolite schist which traverse the county at intervals striking northwest, and is exposed in some of the deep canyons and along the higher ridges where these are not covered by lava. Another rock commonly called soapstone, but different in its rock associations from the above and really a mica schist, is found in some of the older rocks of the higher mountains, but has been used only a little locally for fireplaces.

McLean Soapstone Mine contains 19 acres in Sec. 32, T. 22 N., R. 5 E., on north side of North Fork of Feather River midway between Intake and Blinzig, on Western Pacific Railway. Walter S. McLean, 1919 San Bruno avenue, San Francisco, owner.

This is one of the first class of deposits mentioned. Because of favorable working conditions, and nearness to the railroad, McLean has been able to produce cheaply. The rock is shipped to the bay cities for use in roofing, etc.

Pulga Soapstone Deposit is on the county road one-half mile south of Pulga, a shipping point on the Western Pacific Railway. W. H. King, Pulga, began production from this property late in 1928. Early in 1929 six men were employed by King working at the deposit.

SAN FRANCISCO FIELD DIVISION

KINGS COUNTY

By Herbert A. Franke, Junior Mining Engineer

Introduction.

Kings County lies in the heart of the San Joaquin Valley, midway between San Francisco and Los Angeles. It is bounded on the east by Tulare County and on the northwest by Fresno; Monterey County adjoins on the southwest, and Kern County on the south. Kings County with an area of 1257 square miles was created in 1893, from a part of Tulare County. Later, in 1909, it was enlarged by the addition of 118 square miles from Fresno County. The population of the county from estimated figures, 1930, is 25,277, and the assessed valuation is $33,724,352.

The county seat, Hanford, with a population of 6976, is the principal city, located in the heart of the fruit and vineyard area. The other chief cities include Lemoore, Corcoran, Stratford, and Armona.

Topography and Streams.

The county is almost a level plain, with the Kings River and the various canals flowing south and west furnishing water for this great agricultural area. The Kaweah River enters the county somewhat south of the Kings River. The Diablo Range traverses the southwest corner of the county, with the Kettleman and Kreyenhagen Hills to the east of it, but the most notable geographical feature of this country is Tulare Lake, which in times past has had a water area of as much as 400 square miles. The lake is entirely dry at present and much of the area is now under cultivation.

Transportation.

The northeastern part of the county is traversed by the transcontinental line of the Santa Fe and two branch lines of the Southern Pacific. Railroad transportation facilities are lacking in the southwestern portion of the county. The Golden State Highway is located just out of the county to the east. Paved roads connect with all of the important centers and with the state highways. A paved state highway lateral traverses the county from the Sierra Nevadas on the east and is now under construction to the Pacific Ocean on the west.

Mineral Resources.

Kings County is ninth in value of mineral production for 1929, accounted for by the bringing in of oil at Kettleman Hills in 1928. Otherwise Kings County is essentially an agricultural county, but deposits of fuller's earth, gypsum, mineral paint, and quicksilver, of undetermined extent, have been found in the county.

MINERAL PRODUCTION OF KINGS COUNTY, 1894[1]-1929.

Year	Brick		Gypsum		Natural gas		Quicksilver		Miscellaneous and unapportioned		
	M	Value	Tons	Value	M cu. ft.	Value	Flasks	Value	Amount	Value	Substance
1894											
1895											
1896											
1897											
1898	1,250	$8,450									
1899	1,650	11,550									
1900	750	5 000									
1901	1,000	5,000								$10,500	Unapportioned 1900-1909.
1902	3,500	19,000									
1903	3,400	24,200									
1904	3,100	23,300									
1905	3,400	24,000					*250	$9,000			
1906	2,800	20,000									
1907	1,000	8,000							100 tons	1,000	Fuller's earth.
1908	3,000	24,000	100	$400					50 tons	1,000	Fuller's earth.
1909	1,000	8,500	100	300	360	$360			100 tons 20 tons	2,000 100	Fuller's earth. Mineral paint.
1910	400	3,200	100	490	1,200	600	100	4,525	100 tons 10 tons	1,000 270	Fuller's earth. Mineral paint.
1911			20	100	1,800	800					
1912			50	200	6,000	1,650					
1913			100	300	1,916	575			20 tons	60 400	Mineral paint. Other minerals.
1914			20	80	150	500			20 tons	160	Fuller's earth.
1915					258	608	[2]			18,000	Fuller's earth, quicksilver.
1916					258	608	[2]			26,180	Other minerals.
1917					3,569	2,777					
1918					2,460	590	[2]			8,639	Other minerals.
1919					2,550	1,630	[2]			49,653	Other minerals.
1920					2,765	1,250	436	28,620			
1921					2,090	980	[2]			4,742	Other minerals
1922					1,790	870				5,936	Other minerals.
1923					1,990	970				585	Other minerals.
1924					1,480	725					
1925					740	440				80	Other minerals.
1926					470	245				475	Other minerals.
1927					[2]					1,599	Natural gas and petroleum.
1928									198,784 bbls.	576,474	Petroleum.
										1,240	Stone, miscellaneous.
										105	Unapportioned.
1929					25,809,765	965,165			1,968,729 bbls.	3,294,668	Petroleum.
Totals	26,250	$184,200	490	$1,870	$25,809,765	$981,343	[2]786	$42,145		$4,004,866	

*Flasks of 75 pounds.

[1]Kings County was created March 22, 1893, from a part of Tulare County, and in 1909 extended by annexing a portion of Fresno County.

[2]See under 'Unapportioned.'

CHROMITE

Chrome float has been found in the serpentine area in the southwest corner of Kings County, near Parkfield, Monterey County, but no active development has as yet taken place.

FULLER'S EARTH

Webb and Mingus Property. Deposits of a gray, clay-like material reported to be fuller's earth are owned by Edward A. Webb and S. M. Mingus, of Coalinga, in the northeastern portion of Kettleman Hills. This holding of 160 acres is in Sec. 26, T. 21 S., R. 17 E., while other holdings of fuller's earth occur in Secs. 20 and 28, T. 21 S., R. 17 E., Fresno County.

Another deposit of fuller's earth is described in Report XIV as in Sec. 13, T. 24 S., R. 17 E., on the edge of the Kreyenhagen Hills northwest of Dudley.

Bibl: State Mineralogist's Report XIV, p. 527; XVII, p. 76.

GYPSUM

A small amount of gypsum is reported to have been produced in 1913 from a deposit in Sec. 13, T. 24 S., R. 17 E., northwest of Dudley. Idle.

MINERAL PAINT

Mineral paint is reported to be associated with the above-mentioned gypsum deposit.

NATURAL GAS

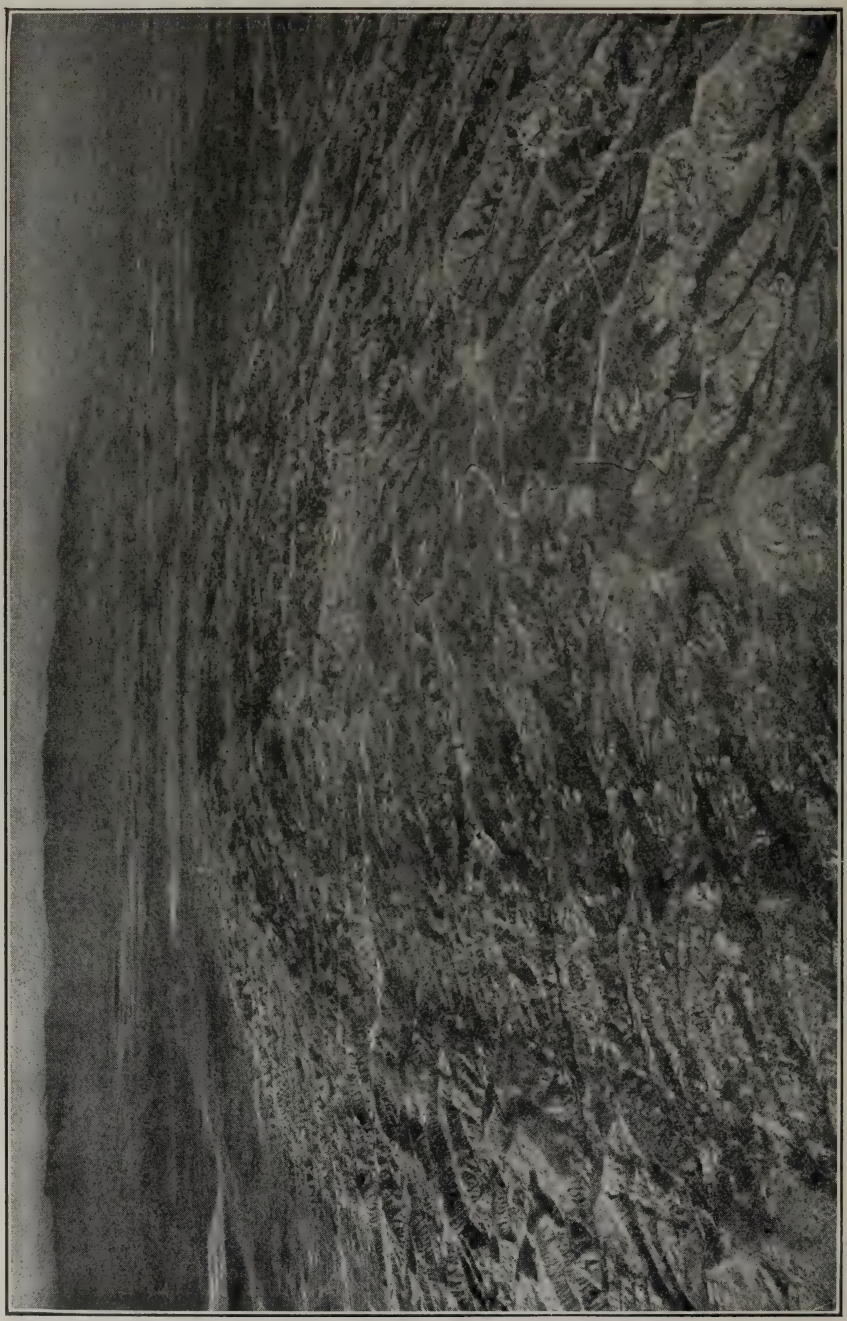
Millions of cubic feet of natural gas are produced daily from the Kettleman Hills oil field, discussed in this report under 'Petroleum.'

Natural gas is also found in many of the water wells in the Tulare Lake region around Corcoran, just north of the general vicinity described under Tulare County, see *post,* page 458. There are quite a few ranches in this vicinity which have or have had this marsh gas produced in their wells. Some of the wells have ceased to give off gas after several years, due to the corrosion of pipes. Galvanized pipe is reported to last longer than iron. Some of the ranches which have gas wells reported on their property are: Burt Bros. Ranch; Hacienda Ranch; Hall Ranch; Hunter Ranch; and Clark and Becket Creamery property.

Bibl: State Mineralogist's Reports XIII, p. 567; XIV, pp. 526, 527–528; XVII, pp. 535–537; Bull. 3, pp. 20, 68; Bull. 19, p. 183; Bull. 89, pp. 177–178; Summary of Operations, California Oil Fields, Vol. 5, No. 6; Vol. 8, No. 1. U. S. Geol. Survey Bull. 398; Water-Supply Paper 398.

PETROLEUM

The Kettleman Hills oil field lies mainly in Kings County, with a small area at the north end in Fresno County and at the south end in Kern County. The area is approximately thirty miles long by five miles wide, lying on the west side of the San Joaquin Valley between Coalinga and Lost Hills. The hills rise to an elevation of about 1200 feet above sea-level out of a plain having an elevation on the west of about 500 feet, and on the east of about 300 feet which is called



Airplane view of North Dome, Kettleman Hills Oil Fields, Kings County, strikingly showing the geologic structure.
Photo by courtesy of Continental Air Map Company.

Kettleman Plains. The trend is northwest-southeast, with a broad curve toward the south opposite the old Tulare Lake bed.

Many wells had been drilled in the Kettleman Hills area prior to the discovery of oil by the Milham Exploration Company in October, 1928, but a large number of these were shallow holes of less than 1000 feet in depth. Probably a dozen or more 500-foot holes have been drilled since the leasing act of 1920, but were of no importance. Musser [1] lists some of the earlier shallow holes in his report, for some were genuine attempts to obtain production. Bulletin No. 19, 'Oil and Gas Yielding Formations of California', published in November, 1900, and U. S. Geol. Survey Bulletin No. 398 published in 1910, records some of these early attempts. The Standard Oil Bulletin of February, 1929, reported the total footage drilled to be 102,253 feet or a little over 19 miles.

Milham Exploration Company's well 'Elliott' No. 1, near the southeast corner of Sec. 2, T. 22 S., R. 17 E., M.D.B. and M., was started on March 21, 1927, and completed, under control, November 7, 1928, with a production thirty days later of 3670 barrels per day of 60° gravity oil. The production is coming from formations between 6317 and 7200 feet.

An average daily flow of about 23,000 barrels of oil and around 600,000,000 cubic feet of gas is reported for the first three weeks of September, 1930, from eight producing wells in Kettleman Hills. There were five gasoline plants in July, 1930, with another plant in construction. About 75,000,000 cubic feet of natural gas is piped to the San Francisco Bay area. A large gas pipe-line was built by the Standard Pacific Gas Line, Inc., and was financed and is to be operated jointly by the Standard Oil and the Pacific Gas and Electric Co. for the dual purpose of supplying the Pacific Public Service Co., a comparatively recent acquisition of Standard's, and augmenting the supply of the Pacific Gas and Electric Co. This line, together with that of the Pacific Gas and Electric Co., has a capacity for transporting 225,000,000 cubic feet of natural gas daily.

An analysis of the oil from the Milham Elliott No. 1 well shows a gasoline yield of 85% of 61.2° A.P.I. gravity, and 5.9% of 41.2°, the residue being 35° gravity. This latter is said to contain approximately 2.5% paraffin. An analysis taken from Musser's[2] report shows that a sample of gas taken after passing through the gas traps yielded:

	Per cent
Methane	85.05
Ethane	7.63
Propane	4.22
Iso-Butane	0.71
Butane	1.41
Iso-Pentane plus	0.98
	100.00

Gasoline constituents found, in gallons per 1000 cubic feet, were:

	Gallons
Propane	1.14
Iso-Butane	0.23
Butane	0.44
Iso-Pentane plus	0.38

[1] Report of the State Oil and Gas Supervisor, Vol. 14, No. 5, November, 1928. (This report is dated April 1, 1929, but owing to great public interest in this field, the report was printed in the November, 1928, 'Summary.')

[2] Op. cit.

Aerial view of portion of the North Dome of Kettleman Hills oil fields, showing developments in the early part of 1930.

Photo by courtesy of the Standard Oil Company of California.

The geology of the Kettleman Hills is described by Musser[1] as follows:

"The Kettleman Hills are a continuation to the south of the Coalinga anticline. Briefly, the structure is a series of three or four anticlines, lying en echelon, generally referred to as North Dome, Middle Dome, and South Dome. Middle Dome is a distinct structure lying mostly in the southwest part of T. 23 S., R. 19 E., and plunges both to the north and south. South Dome lies south of Avenal Gap in T. 24 S., and T. 25 S., R. 19 E. The structure is not known at the southern end of this dome, as this end is open. Many now believe that it is the northern end of the Lost Hills structure. This idea caused a rush for land along the line of the axis northwest of Los Hills. North Dome lies chiefly in T. 21 S., R. 17 E., and T. 22 S., R. 18 E. A portion at the south end, about four miles long, is broken off and may be a separate dome. The discovery well is located at about the center of the northern section of North Dome, about half a mile northeast of the axis. The General Petroleum well is located near the south end of North Dome, six and one-half miles southeast of the Milham well.

"The formations exposed over the surface of the hills were classed by Arnold and Anderson[2] as Tulare (Pliocene Age) and Etchegoin (Uppermost Miocene Age). The Tulare is found over a belt about a mile in width on each side of the hills, and closing around the north end. The Etchegoin is found in the center. Practically all the wells drilled have been at locations where the Etchegoin is the surface formation.

"The age of the productive formation, according to the classification of Arnold and Anderson, is probably Lower Miocene (Vaqueros). The production in the Milham well is known to be coming from formations between 6317 and 7236 feet, and in the General Petroleum well from between 6502 and 6850 feet, and probably between 6770 and 6850 feet. The General Petroleum completion indicates that the whole Vaqueros series may reasonably be expected to contain oil (approximately 900 feet).

"The gravity and character of the oil (semiparaffine base) gave rise to the theory that the oil was coming from the Tejon (Eocene) of Moreno (Upper Cretaceous) as high gravity paraffin oil is obtained from these formations in the Oil City area of the Coalinga field. This theory, however, is not now considered correct.

"Arnold and Anderson,[(a)] in discussing the oil possibilities of Kettleman Hills, state concerning the south side of Sec. 34, T. 21 S., R. 17 E. (one and one-half miles northwest of the discovery well): 'At this point the beds are practically horizontal on the very axis of the fold, and the depth to the top of the Jacalitos is probably only a few hundred feet, possibly about 500 feet. Thence southeastward to Sec. 1, T. 23 S., R. 18 E., the thickening of the formation is more than offset by the pitch of the anticline in the opposite direction, and the depth to the Jacalitos gradually decreases. Thence southward the depth is probably nowhere more than a few hundred feet, and is in general less than in the northern part of the hills.' The Jacalitos formation referred to is classed in Bulletin No. 398 as early upper Miocene age,

[1] Op. cit.
[2] Geology and Oil Resources of the Coalinga District; U. S. G. S. Bull. No. 398.

occurring immediately below the Etchegoin and consisting of 3800 feet, more or less, of 'slightly consolidated marine fossiliferous beds of light gray, greenish gray, blue, and brown sand, clay, and fine gravel, indurated into sandstone, shale, and conglomerate with some siliceous shale.'

"Below the Jacalitos comes the Santa Margarita (Upper Middle Miocene of Arnold and Anderson) with a thickness of between 200 and 1000 feet in the Kreyenhagen Hills located to the west of Kettleman Plains. This formation consists of white, purple, and brown siliceous, calcareous, and argillaceous shales.

"Arnold and Anderson conclude that the combined thickness of the lower part of the Etchegoin, the Jacalitos, and the Santa Margarita, is at least 3500 feet in the northern part and 4500 feet in the south-central part. These figures are based on known thickness of these formations in the Kreyenhagen Hills, the first line of hills to the west, just across the broad valley called Kettleman Plains. It is assumed that the Jacalitos becomes thinner eastward from the Kreyenhagen as the Etchegoin is known to do. Later the following statement is made: 'On the other hand, if the formations are as thick as they are in the Kreyenhagen Hills the top of the Vaqueros would be considerably below 4500 feet, even along the axis of the anticline.' If the logging of the well is correct in placing the top of the Vaqueros at approximately 6300 feet, the Jacalitos and Santa Margarita must be considerably thicker than in the Kreyenhagen Hills, rather than thinner, or the same thickness. The alternatives are that the top of the Vaqueros is actually higher and that production is coming from the Tejon (Eocene) or below, or that some other series of beds intervenes between the Santa Margarita and Vaqueros. What has actually happened is that a considerable thickness of brown shales, increasing in thickness from north to south, has been laid down between the Santa Margarita and the Vaqueros. At the Milham location, the thickness of these beds is roughly 1500 feet; at South Dome, it is over 2000 feet. The formation is identical with the Maricopa shale of the Midway district, and is generally referred to as Maricopa shale or Brown shale.

"According to Bulletin No. 398, the Vaqueros (Lower Miocene) consist of 900 feet of 'Marine fossiliferous gray sandstone and sand with minor amounts of conglomerate and gravel and diatomaceous and clay shale.' The Tejon (Eocene) consist of (a) Upper part, 'Marine white and brown diatomaceous and foraminiferal shale,' (b) Lower part, 'Marine yellowish, brown and gray fossiliferous and locally lignitic sandstone and dark clay, with a local basal conglomerate.'

"Later geologists have discarded or altered the nomenclature of Arnold and Anderson, introducing the term Temblor to include what previously was termed Vaqueros, and the terms Santa Margarita to include Upper Miocene and Maricopa for Middle Miocene. These terms are all loosely used now so that the average person is more or less confused.

"It is generally believed now that the productive horizon is Middle to Lower Miocene age. Whether the formation is called Vaqueros or Temblor is not important. The reef beds, which are so prominently exposed in the Kreyenhagen district, are said to have been penetrated

in the Milham well between 6800 and 6900 feet, and a black shale, prominent in the East Side Coalinga district from 7000 to 7100 feet. It is a fact also that from 6300 to 7236 feet the formation was decidedly sandy except for the interval from 7000 to 7100 feet, which was logged as black shale. Thus it appears that the productive strata resemble the Vaqueros described above more than any of the other formations.

"The underground structure is, of course, still somewhat of a question, even though the oil sand is now known to extend over a large part of the North Dome. Because of the generally continuous surface beds, operators are expecting a similar underground condition. The surface does show numerous traces of faulting, but it is probable that these do not continue to a great depth. The breaks between the various domes and in North Dome itself may be due to faulting. The surface dips are, for the most part, fairly low, ranging from 3 degrees to 30 degrees, with a majority under 20 degrees. These dips are not uniform even in a local area, so it is probable that some are distorted by surface slippages."

Bibl: State Mineralogist's Report XIV, p. 528; XVII, p. 76; Bull. 19, pp. 135–136; Bull. 69, p. 124; Bull. 72; Bull. 89, pp. 174–175. Annual Reports of the State Oil and Gas Supervisor, with particular reference to Vol. XIV, No. 5, and Vol. XIV, No. 11. U. S. Geol. Survey. Bulletins Nos. 357, 396, 398, 406, 721. Bulletin of the American Association of Petroleum Geologists, Vol. 5; Vol. 13, No. 11; Vol. 14, No. 4. Oil and Gas Journal, Vol. 28, No. 46; Vol. 28, No. 45. Petroleum World and Oil Age, Vol. 27, No. 4; Vol. 27, No. 7. The Record (Associated Oil Co. publication), Vol. 11, No. 1; Vol. 11, No. 3. Oil Bulletin, Vol. 15, No. 12. Oil Field Engineering, Vol 8, No. 2. Proc. California Acad. Sci., 4th series, Vol. 7, No. 9. Standard Oil Bulletin, Feb., 1929. Univ. of Calif., Dept. of Geology, Bull., Vol. 10, No. 14; Vol. 10, No. 18; Vol. 9; Bull. Geol. Soc. Am., Vol. 28, Vol. 29. Oil Weekly, Vol. 29; Vol. 60, No. 5. Petroleum World, Vol. 7, Vol. 8.

Numerous other papers, technical publications and bulletins have described the Kettleman Hills vicinity.

QUICKSILVER

Quicksilver occurrences in Kings County are in the southwestern corner, where it adjoins Fresno and Monterey counties. Table Mountain, which is principally of serpentine, is on the boundary between Monterey and Kings counties, and it is here that the quicksilver deposits occur. Parkfield, in Monterey County, is the nearest town.

Dawson Pit. H. Dawson, Lemoore, owner. This quicksilver prospect is located on patented land, in the NW¼ Sec. 28, T. 23 S., R. 16 E. Idle.

Bibl: State Mineralogist's Report XIV, p. 528; XVII, p. 77; Bull. 27, p. 122; Bull. 78, p. 50.

Fairview and Fench Avalloch Group. These quicksilver claims adjoin the Dawson claim and were formerly owned by J. A. Greenlaw

and Joe A. French. Located in the SW¼ Sec. 28, T. 23 S., R. 16 E. Idle.

Bibl: State Mineralogist's Report XIV, p. 529; XVII, p. 77; Bull. 27, p. 122; Bull. 78, p. 50.

Kings Quicksilver Mine. This property was formerly operated by the Kings Quicksilver Mining Co., Ltd., 520 King street, London, Ontario, Canada; but now lies idle. The Segregation and Summit Claims, formerly owned by C. F. Francis of Parkfield, are the chief claims. The group is principally in Sec. 20, T. 23 S., R. 16 E., 14 miles by road east of Parkfield. Elevation is about 3100 feet. The present ownership of the above group is apparently in dispute.

The mine was originally worked about 1902, and again in 1905 and 1910, during which operations it is credited with a total output valued at over $13,000. The Canadian company completed a 10-ton Scott fine-ore furnace in 1914 with brick condensers, which was operated with some interruptions up to the close of 1916. This furnace is now reported to be practically demolished.

The country rocks are serpentine, shale and metamorphic sandstone. The ore values occur in a crushed zone, in part as stockworks, carrying cinnabar and native mercury with some calcite. This zone strikes southeast and dips 45° to 50° southwest. Workings consist of several adits, raises, crosscuts, and drifts.

Bibl: State Mineralogist's Report XIV, pp. 529–530; XVII, p. 77; Bull. 27, p. 122; Bull. 78, pp. 50–52. U. S. Geol. Surv. Min. Res. 1902, p. 253; 1912, Pt. 1, p. 939; 1913, Pt. 1, p. 204.

When this vicinity was visited several quicksilver properties were active nearby in Monterey County, namely: *Patriquin Quicksilver Mine* in Sec. 2, T. 23 S., R. 14 E., six miles north of Parkfield; *Poppy Mine,* N. Gillete, owner, four and one-half miles north of Parkfield; and *Powell and Williams Claims.* The Patriquin Mines, formerly owned by Fred Amstee and Lew Patriquin of San Francisco, had just been sold to the *Bibby Consolidated Mining Co.,* 704 South Spring street, Los Angeles. The entire plant was being overhauled—more equipment being installed. A Gould rotary furnace is used. Ralph Selway is superintendent.

STONE INDUSTRY

(Crushed Rock, Sand, and Gravel)

Adell Cartright Co. A. D. MacDougall, owner. Plant in Hanford. Most of the sand is obtained from Friant, Fresno County, although some of the local sand from various ranches is used. Equipment consists of a concrete mixer with gasoline engine and forms for pipe, tiles, etc. Concrete pipe, building blocks, stone tile, cement, brick, and other cement products are manufactured. An average of ten men are employed throughout the year.

Forkner Concrete Pipe Works. I. R. Forkner, Lemoore, owner. Plant at Lemoore. Sand is obtained from Fresno County, near Friant. A concrete mixer, operated by a gasoline engine, and forms are used in manufacturing the concrete pipe.

N. M. Wilkerson Sand Pit. N. M. Wilkerson has a deposit of sand about a mile and a half west of Hanford which he operates with the use of a scraper and a hoist to load a 6-ton Federal truck.

Many of the ranches in the vicinity have sand suitable for cement work, among which are F. E. Bonstell's sand pit, Foss Field's property, and the A. M. Casella Sand Pit. This material has been produced only in small quantities, all of which has been sold locally.

Bibl: State Mineralogist's Report XVIII, p. 77.

TULARE COUNTY

By Herbert A. Franke, Junior Mining Engineer

Introduction.

Tulare County, one of the largest counties of the San Joaquin Valley, has an area of 4,935 square miles, about the size of the state of Connecticut. It was formed in 1853. The eastern boundary of the county follows the crest of the Sierra Nevada mountains extending north and south for a total of seventy-five miles, embracing a series of the highest peaks in the United States. The county is bounded on the northwest and north by Fresno, on the east by Inyo, on the south by Kern, and on the west by Kings County.

Besides Mount Whitney, the highest peak in the United States, with an elevation of 14,501 feet, there are: Mount Williamson, 14,364 feet; Mount Tyndall, 14,300 feet; Mount Russell, 14,190 feet; Mount Langley, 14,042 feet; Mount Bernard, 14,030 feet, and Mount Le Conte, 13,960 feet, along the Tulare and Inyo county boundary line.

Sequoia National Park lies in the northeastern portion of the county, on the western slopes of the Sierra Nevada. This government reservation comprises an area of 604 square miles, in which there are twelve groves of *Sequoia Washingtoniana (Sequoia gigantea),* or one of the two species of big trees, of California, that contain more than one million Sequoia trees, of which more than 12,000 exceed 10 feet in diameter. The General Sherman tree, monarch of them all, is located in Giant Forest, and measures 279.9 feet in height and 36.5 feet in diameter.

General Grant National Park lies six miles north and west of Sequoia Park, between which there is the Redwood Canyon body of big trees. The General Grant tree, second only to the General Sherman tree in size, is 264 feet high and 35 feet in diameter.

The estimated population of Tulare County for 1930 is 77,375. The assessed valuation of the county is $97,250,548. The principal cities are: Visalia, Tulare, Porterville, Dinuba, Strathmore, Exeter, Lindsay, Terra Bella, Ducor, Lemon Cove, Angiola, Earlimart, Pixley, Alpaugh, Woodlake, and Traver. Visalia is the county seat.

Watershed and Geology.

From the crest of the Sierras on the eastern boundary flow the Kaweah and Tule rivers, also Deer Creek, White River (a creek), and Poso Creek. St. Johns River, Cameron Creek, Deep Creek, Cross Creek, and Elk Bayou derive their source from Kaweah River, branching out as delta streams from this main stream. This is the greatest

MINERAL PRODUCTION OF TULARE

Year	Gold, value	Silver, value	Brick		Gems, value	Granite	
			M	Value		Cubic feet	Value
1880	$1,125	$526					
1881	8,181	36					
1882	5,000	2,000					
1883	4,000	1,000					
1884	70,000						
1885	7,500						
1886	6,900	50					
1887	15,640	167					
1888	25,000						
1889	39,340	250					
1890	43,019						
1891	15,095						
1892	24,355	11					
1893	12,818						
1894						4,668	$10,000
1895	16,320					3,000	2,500
1896	20,092					2,800	4,700
1897	12,830	214				3,600	8,000
1898	12,400		300	$2,000		700	1,500
1899	13,610		600	4,200		1,200	3,000
1900	10,445	433	650	6,100		1,500	3,000
1901	14,616	100	1,600	8,600		9,000	18,000
1902	11,648		4,500	27,000	$500	1,790	4,000
1903	9,215		1,500	9,500	500	3,000	2,260
1904	1,100		1,250	10,000		7,000	16,000
1905	2,300	13	2,000	16,000	5,000	7,000	9,000
1906	20		1,500	12,000	209,790	7,000	9,000
1907			2,500	20,000	26,206		
1908			2,250	18,000	62,250		
1909			6,620	42,400	58,000		
1910			8,195	64,000	104,000	700	1,500
1911			10,225	81,000	20,000		
1912			10,900	70,500	5,350		
1913			6,000	45,000	1,500		
1914			6,838	47,507			
1915			5,520	33,364			
1916			6,330	48,500			[2]
1917			6,771	112,938			[2]
1918			[2]		[2]		[2]
1919			and tile	34,978			[2]
1920			[2]				
1921							[2]
1922			[2]				[2]
1923			[2]				[2]
1924			[2]				[2]
1925			[2]				62,260
1926			[2]				[2]
1927			[2]				[2]
1928			[2]		[2]		[2]
1929			[2]				[2]
Totals	$402,569	$4,800		[2]$713,587	[2]$493,096		[2]$154,720

[1]Includes crushed rock, rubble, sand, gravel.
[2]See under 'Unapportioned.'

COUNTY, 1880-1929.

Magnesite		Miscellaneous stone[1], value	Miscellaneous and unapportioned		
Tons	Value		Amount	Value	Substance
			80 tons	$960	Limestone.
			1,000 bbls.	1,500	Lime.
200	$1,500		22 tons	88	Gypsum.
3,511	28,210				
2,450	19,250				
1,300	19,600	$100			
2,800	9,100			50,108	Unapportioned, 1900-1909
2,380	21,420		400 tons	2,200	Gypsum.
6,567	52,642				
			2,803 lbs.	360	Copper
6,468	47,200			185	Natural gas.
7,110	35,550		2,000 M cu.ft	1,000	Natural gas
7,763	57,335				
6,684	66,840		100 cu. ft.	200	Marble.
			80 tons	200	Quartz.
7,858	62,864	4,350	392 cu. ft.	796	Marble.
			1,429 tons	5,050	Feldspar
			1,250 tons	2,400	Quartz.
9,650	96,500	1,750	2,830 tons	13,065	Feldspar.
			6 cu. ft.	30	Marble.
			1,349 tons	1,888	Limestone.
11,574	104,166	36,851	1,800 tons	6,500	Feldspar.
				1,830	Chromite and silica.
			3,435 tons	42,555	Chromite.
87,606	737,130	82,255	1,422 lbs.	350	Copper.
				36,410	Feldspar, granite, limestone, marble, silica.
			450 tons	11,000	Chromite.
136,562	1,238,853	75,594	240 tons	1,580	Feldspar.
				60,023	Building, tile, copper, graphite, limestone, talc.
			600 tons	24,000	Chromite.
			444 tons	2,928	Feldspar.
28,826	269,748	125,407	8,400 tons	32,400	Limestone.
			204 tons	1,143	Silica.
				71,782	Brick, gems, granite, soapstone, talc, tile.
			10,347 tons	46,388	Limestone.
18,765	186,601	10,811	700 M cu. ft.	295	Natural gas.
				51,928	Chromite, feldspar, granite.
35,305	394,169	8,465	400 M cu. ft.	195	Natural gas.
				190,467	Brick, feldspar, granite, limestone
			10,030 tons	40,090	Limestone.
11,454	125,594	284,122	380 M cu. ft.	190	Natural gas.
				102,238	Brick and granite.
17,223	181,842	151,000	380 M	190	Natural gas.
				189,662	Brick, tile, granite, limestone.
			380 M	190	Natural gas.
24,058	298,272	1,990	15,500 tons	57,500	Limestone.
				108,607	Brick, granite.
21,203	271,830	80,411	1,080 M	540	Natural gas.
				145,893	Brick, hollow tile, granite, limestone.
			280 M	175	Natural gas.
18,150	245,557	47,176	13,300	43,900	Limestone.
				27,911	Brick, lime.
			593 tons	7,709	Lime.
13,378	138,347	73,881	18,000 tons	70,000	Limestone.
				107,983	Brick, hollow tile, granite, natural gas.
	[2]	15,082		459,091	Brick, hollow tile, granite, lime, limestone, magnesite.
	[2]	108,419		336,947	Brick, gems, granite, lime, limestone, magnesite.
	[2]	24,932		262,949	Brick, granite, limestone, magnesite.
488,845	$4,710,120	$981,596		$2,623,569	

watershed in area of any of the valley counties, and supplies water power for five hydroelectric plants.

Bodies of serpentinized peridotite occur associated with the granitic rocks and thin belts of limestone in the first foothills east of Exeter, Lindsay and Porterville. This is where the principal magnesite deposits are found. An exposure of heavy thick-bedded limestones and masses of dark siliceous slates containing important ore-bodies occur in the Mineral King district, about 60 miles east of Visalia. The mountainous eastern part of the county is composed essentially of the deep-seated granitic rocks, including granites, diorites, grano-diorites, and gabbros.

The western valley portion of the county, just east of Tulare Lake is composed of nearly level sands, gravels and clays, of Quaternary age. Near Ducor there is a small area composed of heavily-bedded marine sandstones and diatomaceous shales, clay shales, and gravels, of lake origin and of Tertiary age.

Transportation.

Tulare County is traversed by both the Southern Pacific and Santa Fe railroad systems with their main lines and branches; having a mileage of 300 miles in the county. The Visalia Electric Railroad Company operates between Visalia and Redbanks, via Farmersville, Exeter, Lemon Cove and Woodlake. The county has a system of paved roads that connects all the towns and cities of the county and the Golden State Highway passes through the county from north to south. Transportation facilities are excellent, except for the remote mountain districts, where trails must be used.

Mineral Resources.

The county has many mineral resources, much of which is undeveloped, and includes antimony, asbestos, brick and tile, clay, chromite, copper, feldspar, gold, graphite, gems, infusorial earth, lead, limestone, magnesite, manganese, marble, molybdenum, natural gas, quartz, glass sand, silver, soapstone, talc, miscellaneous stone, and zinc. It stood fortieth on the list of mineral producing counties in 1929, the decrease from the 1928 value being due mainly to granite and miscellaneous stone. A small production of low-gravity oil has been encountered near Terra Bella the last few months (July–September, 1930), and drilling is active in that section of the county.

HYDROELECTRIC POWER PLANTS

Southern California Edison Co. (formerly Mount Whitney Power and Electric Co.). The water supply of the four plants of the Southern California Edison Co. in Tulare County is derived from two distinct watersheds of the western slope of the Sierra Nevada Mountains. These comprise the East, Middle, and Marble forks of Kaweah River, and two forks of Tule River. The former watershed, the more northerly, has an area of 250 square miles and its elevation ranges from 2600 to 12,400 feet at its eastern boundary. The latter watershed has an area of 88 square miles and its elevations rise over 10,000 feet. A characteristic of both watersheds is the rapid fall of the gradient. This will amount to 300–400 feet to the mile, and follows the general pre-

cipitous nature of the rugged country. Above 4000 feet a heavy covering of snow is found throughout six months of the year, and at the extreme altitudes much snow remains the year round. The water flow during the melting time is necessarily large. The precipitous cañons afford little possibility for the construction of reservoirs. A number of small natural lakes have been enlarged by the construction of dams, and these serve to augment the low-water flow.

Kaweah Plant No. 1.

This power house is on the south bank of Kaweah River, about two miles below the junction of the Middle and East forks, and is about 4 miles east of the town of Three Rivers. The power house building has just been rebuilt, with reinforced concrete. There is one main generating unit and excitor unit in the power house building. The generators are Allis-Chalmers, 3-phase, 2300 volt, 2250 k.w., operating at 600 r.p.m. There are four Westinghouse oil-insulated and self-cooled transformers, each having a capacity of 1000 k.w. The entire unit is fully automatic.

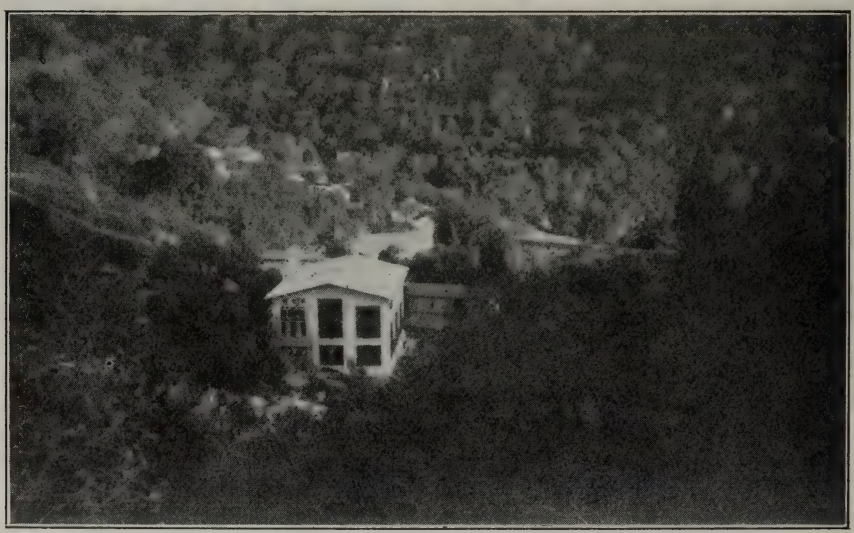
Diversion for the plant is in the East Fork of Kaweah River about five miles above its junction with the Middle Fork where 20-cu. ft. per second flow is available during the season of low water, storage being secured from several natural lakes in the high Sierras. These include Lady Franklin Lake, impounding 23 million cubic feet of water, Silver Lake, Eagle Lake, and Monarch Lake, whose estimated storage is 21 million cubic feet. The diversion is at the outlet of the natural basin where a small, granite masonry dam maintains the water level for the intake of the conduit. A 50-foot tunnel through a jutting rock spur delivers from this basin to a timber flume. This flume has a capacity of 17-cu. ft. per second and is 30,000 feet long, following the very precipitous mountain side of the south slope of the canon. The flume is 3 feet wide by 2 feet deep with a grade of 20 feet to the mile. The plant is served by a pressure pipe 3300 feet long. The pipe has a diameter at the top of 24 inches, and the thickness is No. 12, B. W. G., with lap-riveted construction. As the pipe descends, the diameter decreases to 23, 22, 21, and finally 20 inches, of which diameter the last 1160 feet is in lap-welded pipe. The thickness at the power house is $\frac{1}{2}$ inch. The pipe line terminates into one main water wheel nozzle. The static head on this line is 1350 feet, and the plant has a capacity of 1450 kilowatts.

Kaweah Plant No. 2.

This plant is located across the river about a mile below No. 1 plant. This lowhead installation plant, with pipe line static head of 351 feet, has also recently been changed. The diversion is in the Middle Fork about one mile above its junction with the East Fork. This diversion was made at a natural dam site, between two granite ledges and consists of a low granite masonry dam whose maximum height is 8 feet. At the west end of the intake for the canal are four hand-operated sluice gates, each 2 ft.-5$\frac{1}{2}$ in. wide by 6 ft.6 in. high. The canal follows the hillside for a distance of four miles, of this, 3.15 miles is in a concrete-lined ditch. The remainder is divided into several sections of timber flume. This conduit has a capacity of 80 cubic feet per second. The ditch is 4$\frac{1}{2}$

feet wide at the bottom and 11½ feet at the water surface with a depth of 3½ feet. The grade is 5.28 feet to the mile. At the lower end is a set of five sliding gates to allow the water to pass into the head of the

Southern California Edison Company's Tule River Power Plant, Tulare County.



Pacific Gas and Electric Company's Power Plant at junction of North and South Forks of the Middle Fork of Tule River, Tulare County.

pressure pipe line. The elevation of the intake of this canal is 1400 feet. The pipe line has a total length of 1000 feet, and a single diameter of 40 inches. There are two branches in this final section of the pipe, which supply water to two generating units.

This plant consists of a General Electric 1800-k.w., 2300-volt, 3-phase revolving field generator, operated at a speed of 720 r.p.m. It is direct connected to a Pelton-Francis type turbine. This unit is fully automatic. A General Electric 1500-k.w., 2300-volt, 3-phase generator operating at a speed of 720 r.p.m., is direct connected to a Pelton-Francis turbine, having a capacity of 2250 h.p.; and is semi-automatic. There is one General Electric 4-pole, 125-volt, 30-k.w., exciter, which operates at 1050 r.p.m.; and is connected to the motor. There are four Westinghouse 750-k.w. oil insulated transformers. The capacity of the plant is 1450 kilowatts.

Kaweah Plant No. 3.

The power house is located directly above the intake of No. 2 plant, so that its discharge is caught behind the dam of No. 2 and immediately diverted into that canal. No. 3 plant derives its water from two diversions, one in the Middle Fork, about ¾ of a mile from the junction of the Marble Fork, while the other is in the Marble Fork, about the same distance from the junction already mentioned. The canal is carried along the north bank of the Marble Fork above the junction of the two branches, then an inverted siphon, which is a steel pipe 48 inches in diameter, carries the flow from the Marble Fork diversion across the Middle Fork to the point where it joins the main canal. Where the pipe crosses the bed of the Middle Fork, it is buried in solid concrete. The length of this inverted siphon is 1085 feet, and the maximum static head is 125 feet. The waters of the two branches are thus mingled, and are then carried in a continuation of the Middle Fork conduit, which follows the east slope of the Middle Fork to a terminus in a forebay reservoir for the No. 3 power house. The total length of this concrete conduit, including both branches, is 25,000 feet. Of this 5000 feet comprises the section from the diversion in the Marble Fork, including the inverted siphon. The Middle Fork branch is 3300 feet long. The remainder is the conduit from the junction to the forebay reservoir. The Marble Fork and main sections are built upon a grade of one foot in 1000 feet. Of this 6000 feet is in a concrete-lined ditch having a bottom width of 6 feet, and a depth of 4 feet. The remainder of this branch is in slab bench construction, of which 12,700 feet is in single slab construction, and 3000 feet in double slab construction. That part of the main canal which receives its water from the Marble Fork, is built on a grade of 2 feet in 1000 feet. This section consists of 3300 feet of concrete flume, having a width of 6 feet inside and a depth of 2 feet. The forebay reservoir at the terminus of the line has a capacity of 11½ acre-feet. Intake from pressure pipe line is direct from forebay reservoir to power house. Total length of pressure pipe is 2589 feet. Diameter at top is 40 inches and is reduced to 36 inches; at which size it enters the power house. The total static head is 776 feet. The power house is a reinforced concrete building 50 ft. by 50 ft. inside measurements. This plant consists of two 1750-k.w., 2300-volt, 3-phase, Westinghouse generators, direct-connected to Pelton-Doble impulse wheels operating under a head of 776 feet. There are four 1000-k.w. Westinghouse transformers, 2300 to 66,000 volts. This plant is semi-automatic and has a capacity of 3800 kilowatts.

Tule River Power Plant.

This plant is situated 1½ miles above Springville. The water supply is secured from the Nelson and Doyle forks of Tule River. The main conduit follows the north slope of Tule River Canyon to a point where the river makes a bend to the north. The line itself is composed of 23,600 feet of wooden flume, 11,206 feet of concrete-lined ditch and 228 feet of concrete flume. The total length of the conduit is 6.9 miles. At the terminus of the canal is a small regulating reservoir with a capacity of 17,500 cubic feet. The pressure pipe line to the power house enters the forebay reservoir and is carried from the reservoir directly down the hillside to the power house. The total length of pipe is 2814 ft. The power house contains two 1150-k.w. 2300-volt, General Electric generators, driven by Doble wheels, operating under an 1130-ft. head. An auxiliary steam station, having a capacity of 6750 k.w. is located at Visalia.

Pacific Gas and Electric Co. (formerly San Joaquin Light and Power Co.). The plant is located at the junction of the North (Doyle) and South (Nelson) forks of the Middle Fork of Tule River and takes its water supply from the former. The conduit is 3¼ miles long and consists mostly of short tunnels connected by sections of open conduit. The watershed tributary to the intake aggregates 35 square miles. Later on it is planned to provide a conduit from the Nelson Fork, which will make 28 square miles of the upper watershed of that branch tributary to the plant. About 3½ miles of conduit will have to be constructed along steep and rocky slopes. The output of the plant from 1914 to 1927 averaged 21,145,000 kilowatt hours annually. With a high head of 1425 feet this plant has a capacity of 5200 kilowatts.

The power house is a reinforced concrete and steel structure. The station contains two units placed wheel to wheel; each operated by a single rotor. The pipe line enters at the center of the back of the building, and on each side of it, on the ground floor, are two transformers. The switching apparatus is in a balcony above the transformers.

Each unit is operated by a single over-hung impulse wheel which is supplied through a needle nozzle of 5⅞-inch bore, operating in connection with a relief valve in the main pressure line. The entire hydraulic and electric equipment was furnished by the Allis-Chalmers Co. Each wheel carries 19 buckets, is 71 inches in diameter on the pitch line, and is rated at 5000 horsepower. The two generators, identical in design, are Allis-Chalmers 3000-kilovolt-ampere 2300-volt 3-phase 60-cycle alternators, operated at 400 revolutions per minute. A 120-kilowatt 120-volt 1000-ampere exciter, with sufficient capacity to furnish current for both main units, is mounted on each generator shaft. The entire output of the plant is stepped up to line voltage by a single bank of three 1-phase 2300/40,000/69,000 Y 2000-kilovolt-ampere transformers, and the station is provided with one spare transformer to be used if accident occurs in any of the bank. As the waters of the Tule are highly mineralized and would probably clog up small circulating pipes, the transformer cooling is accomplished by circulating the oil, instead of circulating water in coils through the oil, as is the usual practice. The line outlets are through wall bushings above the door in the end of the power house. The line from the power house runs down

the canyon past the Edison Co's Tule River plant and out across the valley to Strathmore, where the company has located a switching station to tie the power house in on the East Side line. The power house is equipped with electrolytic lightning arresters designed for 60,000 volts potential.

Bibl: State Mineralogist's Report XV, pp. 901–904; XVIII, p. 520. Calif. State Division of Engineering and Irrigation, Bull. No. 3, "Water Resources of Tulare County and Their Utilization." Journal of Electricity, Power, and Gas, Vol. XXXI, "System of Mt. Whitney Power and Electric Company," by R. W. Van Norden. U. S. Geol. Survey Water-Supply Paper 493, "Hydroelectric Power Systems of California," by F. H. Fowler. "Report to the Federal Power Commission on the Water Powers of California, 1928."

MINES

ANTIMONY

Bearhive Claim. Situated about 4 miles south of Mineral King. J. J. Davis, Mineral King and Woodlake, owner.

Lady Alice Mine. Located ¼ mile south of Mineral King, on slope of ridge west of East Fork of Kaweah River. A quartz vein, 2 ft. wide, slightly mineralized with antimony sulphide strikes N. 10° W. and dips 50° W. Slate formation. Workings consist of a few shallow prospect holes sunk along the outcrop of the vein. Idle.

ASBESTOS

Some small deposits of asbestos, of doubtful commercial value, are located in the serpentine area east of Porterville. Some of the localities which may be mentioned are: McCann Ranch, 1 mile south of White River; James Ranch, north of Porterville; F. Gill properties, Exeter; and Frazier Valley in T. 20 S., R. 29 E., on Tule River, 25 miles east by south of Tulare.

BARITE

Baumann Ranch Barite Prospect. Glover Baumann, 754 W. Inyo St., Tulare, owner. This barite prospect is located on the Baumann Ranch, 15 miles east of Exeter, and has only been trenched. Further developments as to the extent and quality of the deposit are planned soon.

Paso-Baryta Mines, Ltd. R. A. Fredericks, 619 17th St., Merced, in charge. This company, incorporated under the laws of California, is reported to have commenced operations on a barite deposit in southeastern Tulare County near the Tulare-Inyo County line. A road is being built to the property at the present time. It is planned to ship the crude barite via the Southern Pacific Railroad in Inyo County.

Bald Mountain Barite Deposit. Harvey Clark and Bill James, Isabella, have located seven claims near Rattlesnake Creek on the upper Kern River. This barite prospect is reported to run high in percentage of $BaSO_4$, but is undeveloped. The country rock is said to be slate and schist. Elevation is between 8000 and 9000 feet.

CHROME

A number of chromite deposits of good commercial grade are located in the foothills north and southeast of Porterville. The lens-shaped deposits are in serpentine belts striking northwest, and are generally small and of shallow depth.

Waddell Chrome Mine. Frederic Gill, Exeter, owner. Located 4 miles northeast of Lindsay, in Secs. 17, 20, T. 19 S., R. 27 E. Lenses of chrome, striking in a direction N. 40° E., occur in serpentine. The property has been idle since 1917, when several tons of ore were shipped.

Vaughn Ranch Deposit. A considerable tonnage of chromite was shipped from lenses on this property, in 1916, and a smaller amount in 1917. It is located 4 miles southeast of Porterville. Now idle.

Bibl: State Mineralogist's Report XV, p. 907, XVIII, p. 523; Bull. 76, p. 213.

CHRYSOPRASE

Deer Creek Land Co. A. Shinkle, owner. A. L. Jamison is mining this deposit of chrysoprase, located about 9½ miles southeast of Porterville. The stone is sold to jewelry firms in Los Angeles.

Chrysoprase outcroppings have been traced at different places all along the foothills of the Sierra Nevada across Tulare County, and the following locations have been mentioned in different reports: Deer Creek, Tule River, Stokes Mountain, Venice Hill, and one mile east of Lindsay.

Bibl: State Mineralogist's Report XV, p. 910; Bull. 37, pp. 154–155.

CLAY

Good quality common clay for the manufacture of red-burned structural ware is plentiful in the valley and foothill section of the county.

Sears Clay Deposit. W. A. Sears, Porterville, owner. This clay deposit is located eight miles southeast of Ducor, in Secs. 26, 27, 35, T. 24 S., R. 28 E., M. D. M. This clay-bearing strata extends about one-half mile south of White River and is about two miles in length along the south bank of the river. An overburden of gravel and clay 6 to 8 feet thick overlies a bed of white and blue plastic clay. Analyses of this clay are given in Bulletin 99, which show that some of the clay may be used in face brick and terra cotta. Undeveloped.

Bibl: State Min. Bur. Prel. Rept. 7, p. 100; Bull. 99, pp. 232, 282, 314, 316; Report XV, p. 905.

S. P. Brick and Tile Co. H. W. Shields, president; L. E. Hayes, manager. General office, 1501 Pacific Southwest Bldg., Fresno. The plant is three-quarters of a mile northwest of Exeter, in Sec. 14, T. 19 S., R. 26 E., M. D. M. The property comprises 20 acres, all of which is underlain by workable gray clay averaging 28 feet, underlain by coarse gravel. Common brick and hollow tile are manufactured.

A ⅜-yd. electric shovel mines the clay, having a capacity of 200 tons per eight hours. The clay is hauled to the plant in cars mounted on a track and pulled by mules, where it is dumped into a hopper and passed through a roll disintegrator, from which it is elevated by belt to a set

of Hummer screens (12 ft. long by 5 ft. wide). It then passes to an American pug-mill and auger machine equipped with a Freese cutter. All of the ware is dried under sheds, which have a capacity of 550,000 brick, and drying is usually completed in three weeks.

The tile and brick are fired in six open-field kilns, with a capacity of 100,000 bricks each. Oil, atomized with steam, is used for fuel. The firing period is 5½ days, and the kiln turnover cycle is 12 days. Two round Stewart down-draft kilns are available, but are not used, as they are more expensive to operate than the plant kilns.

Around 45,000 bricks are produced daily and 150,000 to 200,000 hollow tile yearly. Electric power is used. About twenty-two men are employed.

Bibl: State Mineralogist's Report XVIII, p. 523; Prel. Rept. 7, p. 101; Bull. 99, p. 232.

Plant of S. P. Brick and Tile Company, northwest of Exeter, Tulare County.

Valencia Heights Shale Deposit. A strata of black clay shale, almost a slate, 1500 feet to 2000 feet in width, cuts through the serpentine belt about 6 miles east of Porterville, in Sec. 34, T. 21 S., R. 28 E. The strike of these shale beds is northwest with dip of 75° SE. A report on a sample tested is given in Bulletin 99, p. 327, which shows it to be a good clay for common brick and hollow tile. C. H. Weed, Porterville, owner.

Bibl: State Mineralogist's Report XV, p. 906; Prel. Rept. 7, p. 101; Bull. 99, p. 232 and p. 327.

COPPER

Some very promising copper prospects appear in this county, but have not been developed extensively due to the ruggedness of the country and their distance from transportation. A belt characterized by narrow diverging seams or stringers of copper-bearing minerals is evident just

east of Porterville and extends north to Yokohl Valley. The chief copper deposits occur: 30 miles or so east of Porterville, along the North Fork of the Middle Fork of Tule River; Redwood Canyon District; Mineral King; and near Kearsarge Peak in Secs. 34, 35, T. 14 S., R. 31 E.

Annie Fox Mine. Interstate Industrial and Transportation Co., W. T. Perry, Tulare, secretary. This new organization has leased 10 copper claims owned by A. Crowley, T. J. Crabtree, and W. F. Cord, at Mineral King, in Sec. 23, T. 17 S., R. 31 E. The holdings comprise: *Annie Fox*

W. F. Cord at prospect shaft of Annie Fox group of copper claims, Mineral King, Tulare County.

and *Silver Creek* claims with extensions north and south of both; *Iron Cap,* with two north extensions and one west side claim. These 10 claims are situated on the west slope of ridge east of the East Fork of Kaweah River. Elevation about 8000 feet. The ore zone occurs on contact between the limestone and slates, from 5 to 20 ft. wide, covered with an iron gossan. The ore consists of chalcopyrite, associated with iron sulphides and malachite. The general strike of the vein is N. 30° W., with a dip of 70° NE. Workings consist of a series of prospect shafts and short tunnels driven along the outcrop.

The new company proposes to run a 2000-foot tunnel through the center of the group of claims. They also plan to construct a tramway down from Mineral King to the railroad near Lemon Cove. A permit has been asked of the U. S. Forest Service to build this tramway through the Sequoia National Park, but at the time of the author's visit, July, 1930, no final decision had been secured and no work had been commenced on the mine or the tramway.

Bibl: State Mineralogist's Report XV, p. 908.

Gram Copper Prospect. Paul Gram, owner. Property leased by E. A. Orton, J. Shaw and J. Racker. This prospect is located 4 miles east

of Lindsay, in Round Valley. The ore is reported to be chalcopyrite. There is a 75-ft. shaft. Idle.

Hart Prospects. W. H. Hart, Badger; L. N. and H. M. Hart; H. O. and T. Barton, owners. Holdings comprise the following claims: Wauksatch Chief, Lost Wauksatch, Lamb, War Eagle, and extensions on each. All are adjoining except the War Eagle, and are mostly in Sec. 2, T. 15 S., R. 28 E., M. D. M., in the Redwood Canyou district. Redwood Canyon is situated 12 miles, by road, east of Badger, in the U. S. National Forest, north of Sequoia National Park, at an elevation of about 4700 feet. A road leads up to the upper end of the canyon, from which one takes a three-mile trail to the prospects. There is an abundant supply of water, suitable for power purposes; and the vicinity is heavily timbered with redwood, fir, cedar, and pine. W. H. Hart located some of these claims in 1884, but later dropped them, until September, 1928, when they were relocated.

The mineralized area is reported to be about 6 miles long and ¾ of a mile wide, with several distinct veins. Some of the land is patented. The ores are bornite, chalcopyrite, azurite, and malachite. Ore assayed from the Lost Wauksatch is reported to run from $17 to $32.50 in copper, gold, and silver. The veins strike NW.-SE., dipping about 70° NE. Length proven on surface of the Wauksatch is about ¾ of a mile. It has

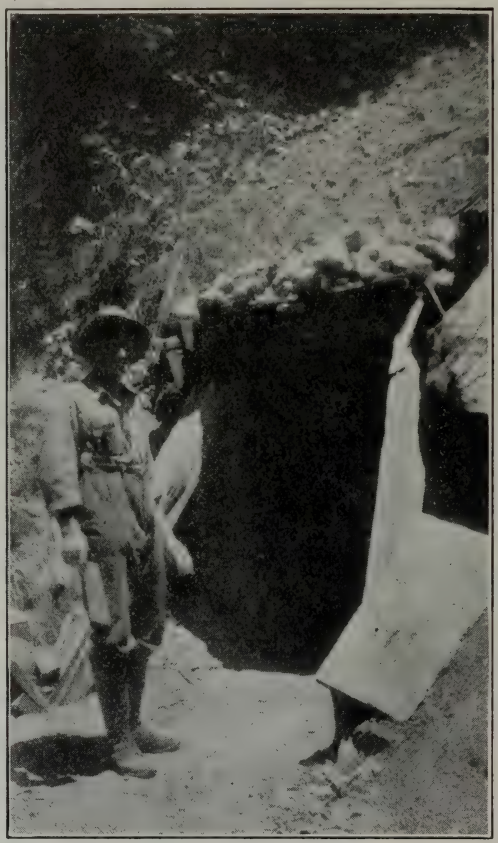
Drift and Shaft, E2, on Powell group of claims, Tulare County.

a lime-schist footwall and a granite hanging wall. The War Eagle vein has been followed for almost four miles and the Lamb about ½ mile. Developments consist only of shallow workings. Assessments only.

Powell Mine. A. M. Powell, Camp Wishon (Springville P. O.), owner. Holdings comprise 12 claims, located in T. 19 S., R. 31 E., about 4 miles above Camp Wishon. The property is in the Sequioa National Forest on Middle Fork of Tule River. Elevation about 5200 feet. Abundant timber includes redwood, fir, and pine.

The following extract is from a detailed report on the property by a private engineer.

"The character of the limestone, its alterations and mineral content, together with the nearby igneous masses, clearly indicates a contact metamorphic ore deposit. * * * Along the contact of the altered limestone and the quartzite and along fractured zones in the lime and its contact with the diorite are very prominent and highly mineralized croppings carrying chalcopyrite, pyrrhotite, pyrite, arsenopyrite, sphalerite and galena in a gangue of altered lime, epidote, amphibole and some chlorite. In the zone near the camp the ore minerals form a very high per cent of the rock, producing massive sulphide outcrops carrying a high copper content with very low lead and zinc. Along the contact south of the camp the ore is mainly zinc with some lead and



A. M. Powell standing at mouth of tunnel G1, 4 miles above Camp Wishon, Tulare County.

generally low in copper. North of the camp the few exposures open, show copper, zinc and a higher lead content than elsewhere. These ore exposures show widths of from a few feet to 15 and 20 feet of commercial grade. Practically no oxidation or alterations of the ore minerals occur except at the north end and at one exposure on the quartzite-lime contact. While the lime is very generally fractured along its bedding planes, together with frequent cross-fracturing, it apparently has not offered favorable channels for surface water oxidation to any depth. Rapid erosion has kept pace with what oxidation there has been and except for a few superficial showings the ores exposed are primary sulphides."

The course of the vein is NE.–SW., dipping SW. Development consists of quite a number of openings on the property, some of which are now caved, for a distance of 3000 feet along the strike. All of the ore exposures in the various workings are close to the surface. Many

trenches have been made along the course of the vein. There are several tunnels—G1, 60 ft; G2, 170 ft.; G3 and G4 about 20 ft; and point F across river with a 30-ft. tunnel and 20-ft. shaft at its portal. Another drift at E2 is in about 50 feet with a shaft down 20 feet. Another shaft is being put down on the contact.

Equipment on the property, besides two log cabins, consists of hand steel, 2 wheelbarrows, hammers, portable blacksmith forge, anvil and tools.

Assessments only. Eight claims owned by Powell are included in the Cedar Hill and Galena Cave groups. (See outline map, under 'Zinc-Lead.') Assays on picked samples sent in by Mr. Powell are as follows:

Bibl: State Mineralogist's Report XV, pp. 909–910; Bull. 23, p. 234; 50, p. 290.

ANALYSES OF COPPER ORE FROM POWELL MINE

Assayer	Sample	Gold, ounces	Silver, ounces	Copper, per cent	Lead, per cent	Silica, per cent	Iron, per cent	Zinc, per cent	Sulphur, per cent	Lime, per cent	Other constituents
U. S. Smelting, Refining and Mining Co.	H.S.S. 1	Trace	7.9	3.1	1.3	13.2	20.2	25.5	25.7	5.2	
	S.F.	.06	9.0	2.16	1.6	----	11.6	25.4	16.6	----	Arsenic 1.0 per cent; Strontium 0.7 per cent; Insolvents 14.0 per cent
R. R. Rogers Chemical Co.	S.F. No.1	.05	6.15	11.28	1.4	----	19.40	1.4	18.74	----	Cadmium, trace; Insolvents, 44.05 per cent.
	E 2	.02	3.78	9.81	0.54	----	26.4	15.45	26.02	----	Cadmium, trace; Insolvent, 10.08 per cent.
Assays from private engineer's report	1	.06	4.0	7.4	----	----	----	----	----	----	
	2	.04	1.0	1.6	----	----	----	3.4	----	----	
	3	.02	4.0	----	2.3	----	----	5.4	----	----	
	4	.04	.8	3.4	----	----	----	11.1	----	----	

Thomas Jacob Estate. An old copper prospect is reported to be located on the estate, about 4 miles southwest of Woodlake, in Sec. 15, T. 15 S., R. 26 E. Two shafts, about 40 feet in depth, were sunk.

Tornado Mine. Fred Maxon, Three Rivers, owner. This copper prospect is located 13 miles southwest of Three Rivers, close to the junction of Burnt Canyon and the South Fork of Kaweah River, a mile above Clough Cave. A shaft has been sunk 20 feet. Assessments only.

FELDSPAR

Britten Ranch Deposit. Noel Britten, Three Rivers, owner. There are massive outcroppings of feldspar of good quality on this property near Three Rivers, located in Secs. 23, 24, 25, T. 17 S., R. 29 E. Undeveloped.

Other idle deposits of feldspar are reported in Tulare County, some of which were formerly known as:

Carter Deposit, ½ mile east of Three Rivers, on the ridge east of the Kaweah River, about 12 miles from the railroad.

Goodale Deposit, near Lemon Cove.

Honora Realty Co.'s deposit, located in Sec. 15, T. 18 S., R. 27 E., M. D. M., 1½ miles from Lemon Cove.

Some deposits of feldspar also occur in Yokohl Valley, from which shipments have been made occasionally in the past.

Bibl: State Mineralogist's Report XV, pp. 911–912.

FLUORSPAR

Annie J. Nash and Camp Nelson Claims, formerly known as the Fluorite King. V. K. Nash, Porterville, owner, reports a massive fluorspar deposit, located in Sec. 34, T. 20 S., R. 31 E., M.D.B. and M., on the Camp Nelson Road, 18 miles east of Springville. Elevation is about 5000 feet. This deposit was first located in 1926 by S. A. Baggs, but abandoned in 1930. Mr. Nash plans to work the Annie J. Nash prospect by tunneling and the Camp Nelson by open quarrying.

GOLD

Gold mining in Tulare County has been carried on mainly in the White River mining district, 15 miles southeast of Porterville. The output of the camp is reported to have been in the neighborhood of $750,000. D. W. C. Biggs and A. J. Maltley discovered the first gold at White River in 1853, locating the Keys claim. Only a small amount of work has been done in this district since 1906, although there was a slight revival in 1922.

The country rock in the White River Mining district is principally granitic, with several streaks of crystalline limestone trending NE–SW. The auriferous veins traversing the granite are fissure veins and the prevailing dip is northwesterly. The veins extend into a formation of micaceous slate in the western portion of the district, with the same general strike and dip as in the granite.

Gold prospects have been located in the past in other parts of Tulare County, notably: on Cow Mountain in Sec. 31, T. 21 S., R. 20 E.; Globe district, 12 miles east of Porterville; Mineral King, 60 miles northeast

of Visalia; Redwood Canyon, 12 miles, by road, east of Badger; and around Fairview, which is on Kern River in the southern part of Tulare County.

Florence and Bertha Prospects. Dan Rickards, White River, owner. These two gold claims are located about 3 miles southwest of White River. A 62-foot shaft is sunk at the Florence. Assessments only.

Guthrie Claims. H. W. Guthrie, White River, has the following holdings about three miles east of White River: Stone, Fiddle, Mystery, Good Enough, Rogers Mine, and Parker & Davis claims. The former is located in Secs. 13, 24, T. 24 S., R. 29 E., while the latter two claims are in Sec. 11, T. 30 S., R. 29 E., and Sec. 14, T. 30 S., R. 29 E., respectively. The *Bald Mountain, Keyes, Ninety-nine, Grubstake,* and *Richelieu* claims are also under option to Guthrie.

The *Rogers Mine* is reported to have a 60-foot incline shaft and a 120-foot tunnel. The *P. & D.* has a shaft down 80 feet and a 900-foot tunnel.

In 1922 the old workings of the Keyes mine were unwatered and cleaned out, and some work done.

A prospectus of the Keyes Gold and Silver Mining Co., of early but uncertain date, shows a capitalization of 60,000 shares of stock, with a par value of $100 per share. Their property consisted of the Talc or Keyes Lode of 1500 feet; the Diamond Lode of 1500 feet; together with mill site, buildings, tools, machinery, engine, boiler, etc. Extracts from this old prospectus give the following history of the mine:

"The *Talc* or *Keyes Lode* was discovered in the fall of 1855, by Robert McCullough and Damon Bullock, who worked the mine from the surface by means of arastras, the ore yielding from $180 to $300 per ton. In 1858, these parties sold the mine to Col. Richard Keyes, who put up a small mill and worked the mine with great success until he sold it to Roberts & Co., in 1861. They sold it to John L. Murphy, who, in a short time thereafter, sold it, with another mine, for $65,000 in gold coin. Col. Keyes always realized handsome profits on the extraction and working of the ores from this mine, and everyone was convinced it was one of the richest mines in the state. The last work done in this mine before Col. Keyes sold out was done by Bishop & Co., of seven persons, who leased the mine for two-thirds of the gross yield. This company realized twelve dollars per day clear of all expenses, after paying Keyes one-third. Bishop & Co., wanted a renewal of the lease, but Col. Keyes did not feel disposed to give it. This comany sunk a shaft 100 feet deep, in order to run under the old works and get ground for stoping. The shaft was sunk upon a spur of the vein, 40 feet from the point of intersection with it, and from the bottom of the shaft a drift was run on the spur 35 feet in length, 12 feet of which runs through very rich ore. This drift will give 80 feet of new ground in the rich chimney and nearly 200 feet in length to work. This drift only lacks 5 feet of cutting the main vein, which, when reached, will expose one of the richest bodies of ore in the state. While the drift was being run from the bottom of the shaft, to tap the vein, one of the principal owners died and the mine was shut down. This happened seventeen years ago. There has been no attempt since to reopen the mine. Since that all there is to be done is to clear the shaft of water and debris, put in new timbers, drift twelve feet north to cross-cut the vein, and extend the drift five feet to the vein, which, by so doing, will give two openings in the vein to work from. Five hundred dollars will do this work.

"The last ore taken out by Col. Keyes milled $260 per ton. This ore was taken from the bottom of an open cut, all from the vein. The last lot of ore taken out by John L. Murphy was three tons, which yielded $700. Four hundred pounds of ore taken out of the drift from the bottom of the shaft netted over $2,000 per ton. The four hundred pounds of ore was worked in San Francisco, and yielded a bar worth over $400.

"The *Talc Lode* is a vertical one, incased in talc and syennite. The vein varies from a foot to two feet in width, and runs into Bald Mountain. There are many parallel veins and spurs that are pitching towards the main vein, which when taken up, will increase the size of it. It is an east and west vein.

"The prospect of this mine is flattering, and it is certain to pay the stockholders well on their investment. The ore in the face of the drift, that is, not yet in the main vein, is good for $50 per ton, and there is only five feet to run in the drift in order to cut the main vein.

"The *Diamond Mine*, of fifteen hundred feet, is west of and on the same vein as the Talc Lode. Two chimneys of ore that worked $100 per ton were encountered, but were not extensive. As it is all new ground, something of importance and value may be developed in the future. There is a large body of low grade ore in sight in this mine, that, when milling facilities are provided, will pay for working."

At present all of the properties are idle, only assessments being done.

Bibl: State Mineralogist's Report XV, pp. 912–915; XVIII, pp. 524–527.

Redwood Canyon Group. S. M. Mingus and Edward A. Webb, Coalinga, and associates, owners. Holdings consist of four lode and four placer claims, situated in Redwood Canyon, tributary to the North Fork of Kaweah River, north of Sequoia National Park. These prospects are in Sec. 35, T. 14 S., R. 28 E., about 12 miles east of Badger. Timber abundant.

The mineral belt lies between schist on the east and granite on the west, with a lime-schist contact. The strike of the vein is NW.–SE., the two ledges being parallel, with about 500 feet of mineralized schist intervening. The ore is reported to run well in gold, copper, and silver. Development consists only of shallow workings.

Southern Mother Lode Claims. A. P. O. Crabtree, Porterville, owner. A gold prospect, including the Uncle Bim, Trying Again, and Dad's Claim, is located 16 miles east of Porterville on Cow Mountain. These were formerly known as the White Chief, Creeks, and E. Henley claims. A series of narrow parallel veins of quartz occur in granite, striking N. 45° W., and dipping 40° SW., in the old Creeks mine. Assessments only.

Bibl: State Mineralogist's Report XV, p. 913; XVIII, p. 527.

Sylvanite Prospect. Harvey Clark, Isabella, owner. Two claims are reported to be located about three miles south of Bald Mountain, below the head of Rattlesnake Creek, tributary to Kern River. Undeveloped.

The following gold quartz mines are idle:

Barton Mine, on Rattlesnake Creek, 2½ miles west of Auckland.

Bibl: State Mineralogist's Report XII, p. 295; XIII, p. 469; XV, p. 913; XVIII, p. 527.

Cherokee Mine, located 2 miles southeast of Mineral King, on ridge east of the East Fork of Keweah River. Holdings consist of three claims: Cherokee Discovery, First North, and First South. Arthur Crowley of Mineral King and Visalia, owner.

Bibl: State Mineralogist's Report XV, p. 913; XVIII, p. 527.

Creeks Mine (see Southern Mother Lode claims).

Eclipse No. 2 Mine, situated 2½ miles southwest of White River.

Bibl: State Mineralogist's Report XII, p. 296; XIII, p. 470; XV, pp. 913–914; XVIII, p. 524.

Florence G. Mine, located on northeast slope of Cow Mountain; in Secs. 30, 31, T. 21 S., R. 30 E.; 14 miles east of Porterville.

Homestake, situated 2 miles southwest of White River.

Bibl: State Mineralogist's Report XII, p. 297; XIII, p. 570; XV, p. 914; XVIII, p. 527.

Josephine Mine, located 3 miles northwest of White River, in Secs. 31, 32, T. 24 S., R. 29 E.

Bibl: State Mineralogist's Report XV, p. 914, XVIII, p. 527.

Last Chance (Redfield) Mine, is situated two miles west of White River, on the east bank of White River.

Bibl: State Mineralogist's Report XII, p. 297; XIII, p. 470; XV, pp. 914–915; XVIII, p. 527.

Minnie Ellen Mine, located 8 miles southeast of Porterville, in Sec. 9, T. 23 S., R. 28 E.

Bibl: State Mineralogist's Report XV, p. 915; XVIII, p. 527.

Stencil Mine, situated 1½ miles west of White River.

Bibl: State Mineralogist's Report XII, p. 298; XIII, p. 471; XV, p. 915; XVIII, p. 527.

Sunset Mine, located 3 miles southwest of White River.

Bibl: State Mineralogist's Report XII, p. 298; XIII, p. 471; XV, p. 915; XVIII, p. 527.

Porterville White Granite Quarry, 4 miles east of Porterville. McGilvray Raymond Corporation, owners, Tulare County.

GRANITE

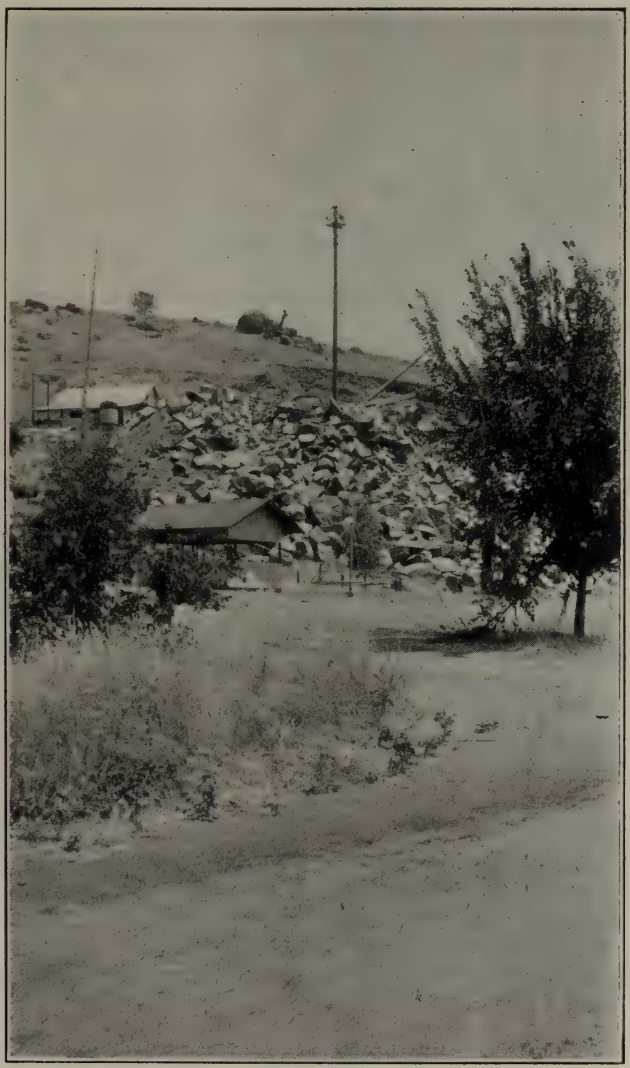
Extensive deposits of biotite-granite, the stone being suitable for monumental, decorative, and building purposes, occur in the foothills east of Porterville and Exeter.

Dickey Property. A. L. Dickey, 119 So. L street, Dinuba, owner. A deposit of dark-gray granite, reported suitable for use as an ornamental and building stone, is located in Sec. 11, T. 16 S., R. 25 E. It is about two miles east of East Orosi, and a distance of two miles from the railroad. The Bank of America Building in Dinuba is built of stone (largely float) from this deposit. Undeveloped.

McGilvray Raymond Corporation's Quarries, formerly known as the California Granite Co. John D. McGilvray, president; H. L. Knowles, secretary; home office, 3 Potrero avenue, San Francisco. This company

operates granite quarries at Raymond, Madera County; Lakeside, San Diego County; Rocklin, Placer County; and two quarries east of Porterville, Tulare County.

The 'Porterville White Granite' quarry is situated 4 miles east of Porterville in Sec. 27, T. 21 S., R. 28 E. Holdings consist of 137 acres. The biotite-granite is of medium-coarse grain, with a fairly straight



McGilvray Raymond Corporation's 'Black Granite' Quarry, Tulare County.

cleavage, and takes a good polish. The general strike of the granite formation is NE.–SW. It is about one mile in width with serpentine on both sides. The rock weighs 180 lbs. to the cubic foot.

There are two derricks on the property, the larger derrick being 100′-10″ high, with a 37″ diameter base, and an 80′ boom that is

3′-1″ in diameter. Other equipment consists of 7/8″ plow-steel cables, two Ingersoll-Rand compressors (10″ x 12″), Sullivan compound hoists, three gang saw (12′-4″ in length by 5′ depth), jack hammers and Burleigh drills. Electric power is used. A three-quarter mile spur track runs to the property from the Springville branch of the Southern Pacific Railroad. The quarry is operated on the 'American Plan.' About 16 men are employed at the two quarries.

The 'Porterville Black Granite' quarry consists of 10 acres of the C. A. Witt lease, on the Success and Porterville road. This so-called 'black granite' is removed in large blocks and loaded on trucks which haul it two miles to the railroad at Howton, where it is shipped to the 'Porterville White Granite' quarry to be cut. Equipment on this property consists of a 90′ derrick, 80′ boom, electric hoist, Ingersoll-Rand compressor and blacksmith shop.

The rock is being used for monumental, building stone, and decorative purposes. A recently built excellent example of the use of this black stone is the Chapman-DeWolfe Building, 341 Montgomery Street, San Francisco. The rough granite is shipped from the two quarries to Raymond, Madera County, for finishing.

C. R. Miel is manager of the two Porterville quarries. Ed. Cramer is foreman of the 'Black Granite' quarry.

Bibl: State Mineralogist's Report XV, pp. 141, 142; XVIII, p. 527; XXIV, pp. 329–334.

Rocky Point Granite Works, R. H. Owen, Exeter, owner. This property comprises 40 acres, located four miles east of Exeter, in Sec. 8, T. 19 S., R. 27 E. The Visalia Electric Railroad runs two miles north of the property. The granite is a gray, fine-grained rock of very uniform texture and color, which splits readily in any direction and takes a fine polish. It occurs in large detached masses and flattened beds, the pitch of the latter is a little east of north, at an angle of 30°. The property has not been actively worked for the past ten years but several old derricks remain on the grounds.

Bibl: State Mineralogist's Report XV, p. 916; Bull. 38, pp. 55, 56.

GRAPHITE

Camp Nelson Graphite Mine, formerly known as the Graphite King, V. K. Nash, Porterville, owner. This large, low-grade graphite deposit is situated in Sec. 34, T. 20 S., R. 31 E., M.D.B. and M., 18 miles east of Springville, on the Camp Nelson Road. Elevation is about 5000 feet. No development work has been done.

Large deposits of graphite have been reported in Grapevine Mountain and Drum Valley districts, near Badger. Undeveloped.

LIMESTONE

Extensive deposits of limestone occur in the foothills and Sierra Nevada Mountains in the eastern part of Tulare County.

Boydston Bros. Quarry. Boydston Brothers, Box 338, Porterville, owners. This deposit of crystalline limestone is located 9 miles southeast of Porterville, near Worth. It is reported to run 97 to 99 per cent $CaCO_3$. The quarry has been practically idle since 1917. Formerly

the limestone was hauled by truck to Worth, where the old lime plant was located.

Britten Limestone Deposit. Noel Britten, Three Rivers, owner. A large deposit of limestone runs through the Britten-Williams ranch, in Secs. 25, 30, T. 17 S., R. 28 E. The property is 9½ miles northeast of Lemon Cove, which is on the Visalia Electric Railroad. The limestone belt is about ½ mile wide, with a general NW.-SE. strike. Analyses of rock from this extensive deposit, from the report by Sill and Sill, M.E., Los Angeles, show:

Location	$CaCO_3$ %	$MgCO_3$	FeO & Al_2O_3 %	SiO_2 %
Lavelle Quarry	98.8	Nil	Trace	0.8
Mt. Blossom siliceous lime	44.7	Nil	0.4	44.8
Britten Peak	98.9	Nil	Trace	0.7
Britten Peak Ls. next to schist	93.4	Nil	0.3	6.2
Fort Hill	99.8	Nil	Trace	0.12
Broder lime kiln	99.7	Nil	Trace	0.13

Bibl: State Mineralogist's Report XV, p. 918; XVIII, p. 529.

Cortner Group Claims. Preston B. Cortner and associates have filed claims on a limestone deposit southeast of Badger, two miles south of Eshom Valley, in T. 15 S., R. 28 E., which is reported to run high in $CaCO_3$.

Devils Thumb Claims. A. P. O. Crabtree, Porterville, owner. This limestone and calcite deposit is located south of the Tule River Indian Reservation, in Secs. 2, 3, 10, 11, 14, T. 23 S., R. 30 E., M. D. M., on Gordon and Tyler Creeks, tributaries of Deer Creek. The deposit is undeveloped and consists of the following claims: Devils Thumb, Devils Backbone, Devils Thumb Jr., Devils Backbone Jr., Flank, and Leach.

F. Gill Property. Frederic Gill, Exeter, owner. This limestone deposit adjoins that of the Valley Lime Co. to the east. Undeveloped.

Another limestone deposit is reported to be located on the Gill properties in Sec. 13, T. 21 S., R. 28 E.

Kaweah Quarries, formerly known as *Kaweah Lime Products Co.,* also *Lemon Cove Lime Quarry.* A. C. Root, Lemon Cove, owner. The quarry and plant are located 1½ miles north of Lemon Cove at Terminus Beach, the end of the Visalia Electric Railroad. Situated in Sec. 35, T. 17 S., R. 27 E. A new quarry face was opened in 1929, east of the former site. Air drills are used. The lime rock is trammed from quarry to the plant, where it is first run through a gyratory crusher. It is screened, the oversize going through another gyratory crusher, and then four Griffin machines grind the rock to two hundred mesh and the product is sacked. Electric power is used. An average of 15 men are employed. The products are: agricultural lime, paving dust, crushed rock, and fertilizers.

Bibl: State Mineralogist's Report XV, pp. 144–145; XVIII, p. 529. Bull. 38, p. 94.

Morehouse Limestone Deposit. This property is located about 15 miles east of Springville, on ridge northeast of South Fork of Middle Fork of Tule River, in Secs. 29, 30, 31, 32, T. 20 S., R. 31 E. Holdings consists of the following patented claims: Surprise, Tule River, Sugar Lime, South Side, Bluff Placer, Bluff No. 2, Jumbo, East End Placers, Mammoth, and Travertine claims, comprising 992.59 acres. The lime-

stone belt cuts through a formation of mica schist and granite. The belt is about ½ mile wide by 7 miles long, and strikes NW.-SE. The deposit consists of limestone, travertine, and silicate rock. Idle. Riverside Cement Company, 200 Bush street, San Francisco, owners.

Bibl: State Mineralogist's Report XV, p. 919.

Kaweah Quarries' lime plant, at Terminus Beach, Tulare County.

Universal Silicate Stucco and Lime Products Corporation's lime kiln, 5 miles southeast of Lindsay, Tulare County. Now idle.

Universal Silicate Stucco and Lime Products Corp. E. B. Swinny, 238 S. Lorraine Blvd., Los Angeles, owner. This lime kiln is located five miles southeast of Lindsay, and is 4½ miles from the lime quarry

now owned by the Valley Lime Co., from where the limestone was obtained. Equipment consists of two kilns with a daily capacity of 25 tons, hydrating plant of the same capacity, crusher, warehouse, and bunkers for the agricultural lime. Electric power was used, and the kilns fired with oil. All kinds of commercial lime was manufactured, but the plant has not been operated since the latter part of the year 1928, and some of the equipment has been sold by E. H. McEuen of Lindsay.

Valley Lime Co., formerly known as the *Abramson & Bode Corporation*. E. H. McEuen and W. J. Resch, owners. Home office, 118 W. Honolulu St., Lindsay, California. This limestone deposit is located eight miles east of Lindsay, in Sec. 6, T. 20 S., R. 28 E., M. D. M. The holding consists of 160 acres of high-grade dark-gray amorphous limestone, reported to run from 97% to 99% $CaCO_3$. The American Appraisal Co. is said to have estimated the tonnage of lime rock at 20 million tons. Equipment on the property consists of air compressors, rock drills, hoist, 700-ft. tramway, 300-ft. narrow gauge track, 100-ton rock bunker, and gasoline engine. The rock is hauled 4½ miles by truck to the railroad at Calcite, where it is shipped for use chiefly in the sugar refineries and as a fluxing stone in the steel mills. An average of 14 men are employed. The capacity is about 200 tons daily. At the time of visit the quarry was temporarily shut down.

MAGNESITE

Tulare County for a number of years led the state in magnesite output, except in 1918 when it was passed by Napa County, and since 1921 by Santa Clara County.

Magnesite deposits were discovered in the county as early as 1853, by W. P. Blake, who passed through this region with the U. S. expeditions making explorations and surveys for a railroad. Active mining operations were not started until 1900.

The main deposits are east of Porterville, Lindsay, and Exeter, these being the railroad points from which shipments have been made. Smaller occurrences extend southerly to a point east of Terra Bella, and northwesterly to St. John River near Kaweah.

The geology of the Porterville deposits have been fully covered by Hess[1] and Gale,[2] and also in Report XV of the State Mineralogist,[3] and in Bulletin 79.[4] Excerpts taken from Report XV are as follows:

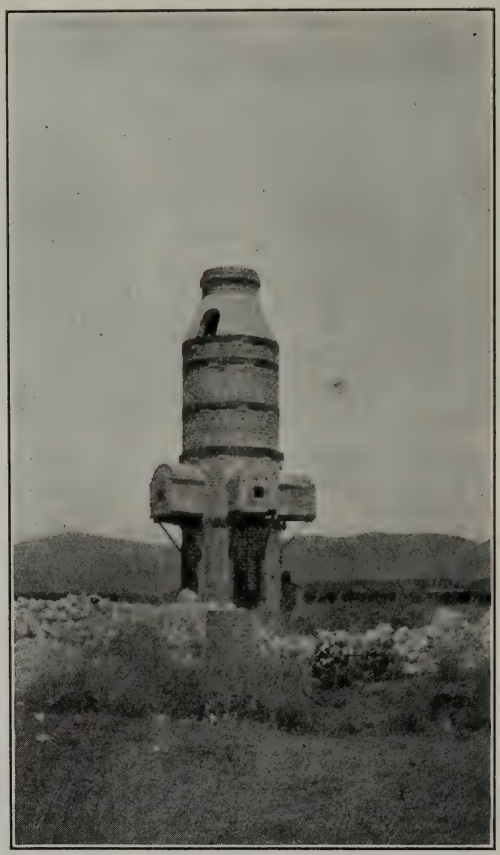
"The magnesite occurs in a shistose serpentine mass which is impregnated with magnesite veins and contains some basalt and diabase intrusions. The country rock is a dull, brown, serpentinized peridotite. The rock is sheeted in places and contains great numbers of vertical, thin, parallel veins of magnesite. Crossing the vertical veins at a small angle is a second series of veins, and a third series crosses at right angles. * * * The veins are probably due to shearing, which caused cracks. These cracks then formed channels for surface waters and were filled with magnesite derived from the decomposition of the enclosing rock and brought by waters from a distance and precipitated. The veins are generally discontinuous and irregular, and of narrow widths."

The principal uses of magnesite include: Refractory linings for basic open-hearth steel furnaces, copper reverberatories and converters,

[1] Hess, F. L., The magnesite deposits of California: U. S. Geol. Surv., Bull. 355, pp. 39–49, 1908.
[2] Gale, H. S., Late developments of magnesite deposits in California and Nevada: U. S. Geol. Surv., Bull. 540, pp. 509–511, 1914.
[3] Report XV, pp. 922–923.
[4] Bradley, W. W., Magnesite in California: Cal. State Min. Bur., Bull. 79, 1925.

bullion and other metallurgical furnaces; in the manufacture of paper from wood pulp; and in structural work, for exterior stucco, for flooring, wainscoting, tiling, sanitary kitchen and hospital finishing, etc.

Crystal White Magnesite Co. This company, with headquarters reported to be in San Francisco, erected a new vertical magnesite-calcining furnace on the Mirador spur of the Santa Fe, about five miles southeast of Lindsay, but never commenced operations. The company intended to purchase the crude magnesite it was to burn in its plant,



New vertical magnesite-calcining furnace of Crystal White Magnesite Co., at Mirador spur, 5 miles southeast of Lindsay, Tulare County. (Idle, never operated.)

until later when they would develop their own raw material. Newspaper reports show that the kiln was built under the direction of James Drummond, but inquiry failed to reveal his whereabouts or any other information as to the plans of the company. Idle.

Harker Mine. These deposits are in the outer range of foothills, located in Sec. 17, T. 21 N., R. 28 E., M. D. M., about 4 miles northeast of Porterville, the nearest railroad point. Mrs. Barngrover, owner. The deposits have been worked extensively by various companies, and

were last operated by the *Sierra Magnesite Company* to the end of 1922. At one time when the Porterville Magnesite Company had the property it was the largest producer of magnesite in the state.

The principal deposits are in two large rounded hills, where the magnesite forms in part, a stockwork of veins in brown serpentinized peridotite, resembling a bedded structure; the veins varying in size from a fraction of an inch to ten feet in width. The ore was mined by means of open cuts, quarrying, tunnelling, and stoping, largely under contract on a per ton basis. Now idle.

Bibl: State Mineralogist's Report XV, pp. 931–935; XVIII, p. 531; XX, p. 30: Bull. 38, pp. 333–334; Bull. 79, pp. 110–117. U. S. Geol. Surv., Bull. 355, pp. 40–46; Bull. 540, p. 509.

Hayden Magnesite Mine. J. T. Hurst, 363 S. Olive St., Los Angeles, present owner. The deposit on Hayden Hill consists principally of a stockwork of magnesite veins. No work has been done on the property since the World War.

Bibl: State Div. of Mines, Bull. 79, p. 118.

Merryman Magnesite Mine. The mineral rights on this property, owned by Fred Gill of Exeter, belong to the R. C. Merryman Estate Co., 210–212 S. Raymond Ave., Pasadena, California. Alva Joyner, Exeter, now has the land leased. The mine is located in the N½ of Sec. 7, T. 19 S., R. 27 E., M. D. M., 1½ miles east of Exeter. The magnesite is on the rounded southwest spur of Rocky Hill, where it occurs as seams and veins in serpentine about 2000 feet from a granite contact. 107 cars (50-ton cars) of magnesite were shipped from this property in 1917, but mining was discontinued after 1923 and it is idle at present.

Bibl: State Mineralogist's Report XV, p. 931; Bull. 79, p. 119. U. S. Geol. Surv., Bull. 355, p. 49.

Sierra Magnesite Company. The officers of the Sierra Magnesite Company are: S. H. Barrows, president, Hunter-Dulin Bldg., San Francisco; J. A. Bernhard, secretary; Max Y. Seaton, vice president, Newark, California; and at Porterville the following: J. B. Perry, mine superintendent; O. Larson, plant superintendent; K. R. Miller, chemist.

This company was organized in 1920, and took over all of the important producing properties in the vicinity of Porterville, which they still retain with the exception of the Harker Mine and Gill Ranch leases. The Sierra Magnesite Co. now owns in fee the properties described in preceding reports of the State Mineralogist[1] under the following names: Tulare Mining Company, Rex Plaster Co., Lindsay Mining Co., and mineral rights of the Oakland Magnesite Co. on 80 acres adjoining the Harker Mine on the north.

Most of the recent operations have been on the 'Tulare' ground and portions of the 'Lindsay' group. No work has been done on the Rex Plaster Mine since the latter part of 1917, and no recent operations have taken place on the 'Oakland' group.

The various properties are briefly described below, further information being found in Bulletin 79, from which some of the data below are taken:

[1] Report XV, pp. 919–940, 1917; XVIII, pp. 528–535, 1922; Bull. 79, pp. 103–137, 1925.

The 'Rex Plaster Mine' comprises the S½ of S½ of Sec. 31, T. 21 S., R. 29 E., M. D. M., in the Success district, 7 miles east of Porterville. Veins of magnesite occur in serpentine and peridotite on rounded hills

Calcining plant of the Sierra Magnesite Company at Porterville, Tulare County.

Crushing and cleaning plant of the Sierra Magnesite Company's mines, at Magnesite Station, Tulare County. (Discarded vertical kilns in center background.)

with grass-covered slopes but bare of timber. The property lies at an elevation of about 1400 feet, and water is obtained from the South Fork of Tule River. Most of the veins are small and were worked largely through open cuts, by hand labor.

The principal shipments from the Rex Plaster property were made in 1916–1917, and no work has been done on this property since the latter part of 1917.

The 'Lindsay Magnesite Mine' comprises 160 acres in the N½ of S½ of Sec. 31, T. 21 S., R. 29 E., M. D. M., situated between the 'Rex Plaster' on the south and the 'Tulare' on the north. The magnesite was opened up in veins in serpentinized peridotite, on a large rounded hill, the average elevation of the earlier workings being about 1200 feet. During 1916–1917 this mine was one of three most important operating in the district, producing in excess of 33,300 tons. The present company is doing some development on this property now.

The 'Tulare Mining Co.' ground, taken over by the Sierra Magnesite Company in April, 1921, comprises the N½ of Sec. 31, and a portion of Sec. 30, T. 21 S., R. 29 E., M. D. M. The portion of the hills containing the magnesite veins is a highly serpentinized rock and the occurrence is typical, embracing both large veins and a stockwork of small veins.

The magnesite veins developed in the workings range from mere seams up to orebodies which have been staked out to a width of 38 feet. The strike of the steep veins varies between N. 80° E. and N. 75° W., with dips up to 80°. In some places the stockwork as a whole has been mined. In the north section, the occurrence is that of a zone of 'nodular' ore and irregular segregations in the serpentine, being a series of discontinuous or intermittent segregations. This zone has a northwest strike, with dip approximately 60° E., and is from 30 to 90 feet wide. This ore back of the main vein has proved up very well.

A spur track southeasterly from Success Station on the Springville branch line of the Southern Pacific Railroad runs up the Tule River to the property. The old calcining plant of the former Tulare Mining Company has been torn down as all of the ore is shipped to the calcining plant at Porterville. The old shaft-kilns formerly served as storage bins but are no longer used. The crude ore is dumped from the cars and run through a Wheeling crusher, elevated, and put through trommels and over vibrating screens, to clean the ore. The ore is then dumped on the cement floor in piles of different grades, where it is loaded onto railroad cars for shipment to the calcining plant at Porterville. From 45 to 100 men are employed at the mines. The output of the Success district was about 40 tons daily at the time of visit, July, 1930, the capacity being 100 tons daily. The output was below normal, as much magnesite was being received from the company's new prospect in Stanislaus County.

The 'Oakland Magnesite' leasehold covers a strip of ground in Secs. 7 and 8, T. 21 S., R. 28 E., between the Harker Mine and the Gill property northeast of Porterville. It is in a narrow valley running westerly and extends up the slope of the hillsides both north and south. This property is not being worked at present, and the compressor plant has been removed.

Calcining Plant.

The calcining and grinding plant of the Sierra Magnesite Company is within the city limits of Porterville, directly on a loading track on the west side of the main line of the Southern Pacific Railroad. The plant was originally built (1915) by the California Magnesite Company,

a subsidiary of the International Magnesite Company, which operated the plant at Chula Vista, San Diego County, on ore from Lower California, Mexico. During 1917–1918, this plant operated on custom ore under management of the American Refractories Company at Joliet, Illinois. That company purchased crude ore which met their specifications, at $8.50 per ton delivered, and supplied their eastern customers with calcined unground magnesite at a contract price of $32 per ton. City water is furnished the plant. The buildings are of substantial wood-frame and corrugated-iron construction.

The crude ore is received by rail and auto truck, and dumped on the ground near the crushers, which are set below grade to facilitate feeding. The ore is crushed in the primary jaw crusher, followed by a Telsmith crusher in circuit with a trommel, sampled, and carried by chain bucket elevators to the storage bins. The furnace feed size is $\frac{1}{2}$ inch. From here it passes through the rotary kilns, the discharge falling on a metchanical conveyor which dumps the hot calcined product on a cooling platform, to be later sacked for shipment or loaded in bulk form into railroad cars.

There are two rotary kilns, one 5′ by 50′, driven by a 10-h.p. variable-speed motor which also runs a small sample crusher and grinder, and one 6′ by 75′ kiln, driven by a 20-h.p. motor of the same type. Only the larger one is being used. The speed has been reduced so that the crude ore travels through the kilns at the rate of approximately 1 foot in 2 minutes, and the capacity is 65 tons of calcined magnesite in 24 hours when both furnaces are operated. About 2.2 tons of crude ore are required to make one ton of calcined. Electric power is furnished by the Southern California Edison Co. Crude oil is used for fuel in the kilns. The oil, after being raised to a temperature of 184° F., is fed to the burners under 90 lbs. pressure, with steam at 100 lbs. Consumption of oil amounts to 1.2 bbl. per ton of calcined product. A 55,000-gallon oil-storage tank is provided. The kilns are lined with fire brick, which must be partly renewed after 12 to 18 months' use.

Twenty-seven men are ordinarily required for operation of the plant, nine being employed on each of three 8-hour shifts. Other help for loading, etc., work in two shifts of nine hours each.

Fine grinding of the calcined material, in preparation for stucco and plaster mixtures, is accomplished in 12 buhr mills in two banks, so that 85% will pass 200 mesh.

The company has adopted different burning ranges for their several grades, and plant conditions are adjusted to accommodate these. These adjustments make for uniformity of products. In calcining they have found that $\frac{3}{4}$-inch is the maximum feed size with which good results can be attained in the rotary kilns, and an average of $\frac{1}{2}$-inch is maintained in practice. The ore remains in the kiln slightly over two hours. If the size is doubled, the time required is quadrupled. In the old Tulare upright kilns, the ore remained 5 hours. Up to 7-inch size was fed. It was noted that there were often unburned cores, even with the outside 'overdone.' The rotary kiln yields a more uniform product. The furnace man takes a sample of the burned material over each 24 hours, and these samples are put through a series of physical tests.

The *National Kellastone Co.*, of which the Sierra Magnesite Company is an associate (being controlled by the same financial interests), has

one of its stucco plants here, where stucco mixtures are prepared for sale to contractors and material dealers. All of the technical control work of the National Kellastone Company is carried on at Porterville in the physical-test and chemical laboratories. Both of these laboratories are especially and completely equipped for such work. Because of the high summer temperatures, there is a below-ground basement room under the physical-testing building for use in the summer months, so that fairly uniform temperatures may be had for testing throughout the year.

Because of their careful technical control a uniform product of guaranteed behavior can be delivered. Their commercial grades, with approximate chemical analyses are as follows (it being understood that the guaranteed physical tests are of more vital concern than a specific chemical composition):

Sierra Standard. White or light-gray color when ground; MgO 89% – 91%; CaO (under 3% total); Al_2O_3 and Fe_2O_3 under 1%; SiO_2 under 5.5%. Ignition loss 2%. Used for finish-coat stucco.

Tulare A. Cream color; MgO 85% – 87%; Al_2O_3 and Fe_2O_3 3%; CaO (3% total, 1.5% active); SiO_2 5% – 6%. Ignition loss 3%. For flooring finish coat; also some for stucco.

No. 20. Color varies, dark cream, light brown, etc. MgO 85%; CaO 3%; Al_2O_3 and Fe_2O_3 2%; SiO_2 7 – 9%. Ignition loss 4%. For base coats, both in stucco and floors.

No. 90, Periclase. 90% crystalline MgO.

No. 93, Periclase. 93% crystalline MgO.

No. 88, Iron. Normal dead-burned magnesite.

Among the new products manufactured are: periclase brick, building tile and floor sleepers. The periclase brick are made of "No. 93 Periclase.' Equipment used at present includes a hand brick press, both low and high temperature dryers, and oil-fired kiln. In making the base and partition tiles, the mixed material is poured into molds and cured in sheds during the winter, but during the summer the tile is cured in the open. Material is poured once every 24 hours.

Periclase, a new product in the magnesite industry, is now obtainable at about one-third of the old price, since the rotary furnace process is used. Formerly artificial periclase had to be made in an electric arc furnace from calcined magnesite.

The *California Chemical Corporation* is also controlled by the same financial interests which control the Sierra Magnesite Co. and the National Kellastone Co. They have plants at Newark, San Mateo, and Chula Vista; producing bromine, bromine compounds, magnesium chloride, lime, potash, etc., from sea water.

Bibl: State Mineralogist's Report XV, pp. 919–922, 928–931, 936–940; XVII, p. 259; XVIII, pp. 531–535; XX, pp. 30–31; Bull. 38, pp. 333–334; Bull. 79, pp. 103–106, pp. 118–119, pp. 123–135. U. S. Geol. Surv., Bull. 355, pp. 46–48; Bull. 540, pp. 509–511.

The magnesite industry declined rapidly after the World War and the other numerous idle properties in Tulare County will only be mentioned below. Further data may be secured from Bulletin 79, 'Magnesite in California.'

Adeline Magnesite Mine is located in Sec. 24, T. 20 S., R. 27 E., M. D. M., 6½ miles east of Lindsay and 7½ miles due north of Porterville.

Blue Crystal Magnesite Group is in Sec. 24, T. 20 S., R. 27 E., M. D. M., 6½ miles southwest of Lindsay.

Chamberlain Ranch Deposits are on the Chamberlain ranch, 8 miles southeast of Porterville, in Secs. 3 and 10, T. 23 S., R. 28 E., M. D. M.

Cross Ranch Deposit is located 3 miles north of Lindsay, in Sec. 19, T. 19 S., R. 27 E., M. D. M.

Deer Creek Mine is on Carroll Ranch, in Sec. 21, T. 22 S., R. 28 E., M. D. M., 8 miles southeast of Porterville.

DeMoulin Mine is in the N½ of Sec. 12, T. 21 S., R. 27 E., M. D. M., about 3½ miles north of Porterville.

Dinuba Magnesite Co. (Weissman lease), near Tulare-Fresno County, line.

Dumont Magnesite Property is located about 5 miles east of Exeter in the rolling foothills, in Sec. 10, T. 19 S., R. 27 E., M. D. M.

Duncan Magnesite Mine is on the Duncan ranch, in Secs. 26 and 30, T. 21 S., R. 28 and 29 E., on the South Fork of Tule River, 6 miles east of Porterville.

Fairview Magnesite Mines are situated in Sec. 30, T. 20 S., R. 28 E., M. D. M., about 6 miles southeast of Lindsay.

Gill Ranch Magnesite Deposits occur at several places on the extensive Lee Gill ranch, as in Secs. 7 and 18, T. 21 S., R. 28 E., northeast of Porterville.

Hamilton Ranch Deposit is in Sec. 22, T. 18 S., R. 27 E., on a hill running easterly in the Yokohl Valley.

Headberg Magnesite Deposit is situated 4½ miles east of Lindsay, in Sec. 11, T. 20 S., R. 27 E., M. D. M.

McKiernan Mine is on west side of the Lindsay Mine of the Sierra Magnesite Co.

Mentz Property is northeast of Terra Bella, in the SE¼ of Sec. 28, T. 22 S., R. 28 E., M. D. M.

Mitchell Magnesite Property is 2 miles east of Exeter.

P. J. S. Montgomery Property in Sec. 24, T. 20 S., R. 27 E.

Simmons Ranch Deposit, located 8 miles southeast of Porterville.

Tulare Mining Co. owns the E½ of the NE¼ of Sec. 28, T. 22 S., R. 28 E., M. D. M., in the Deer Creek Mining District.

Wood Magnesite Mine is on the southeast slope of Badger Hill in Sec. 6, T. 19 S., R. 27 E., M. D. M.

Bibl: State Mineralogist's Report XV; XVII; XVIII; XX; Bull. 38; Bull. 79. U. S. Geol. Surv., Bull. 355; Bull. 540.

MANGANESE

Manganese ore outcrops at various intervals for 15 miles along Dry Creek, near Badger; mostly on patented ground.

MINERAL SPRINGS

Many warm, hot, and carbonated springs are found in the Sierra Nevadas of Tulare County. Gerald A. Waring described most of

these in U. S. Geological Survey Water–Supply Paper 338, 'Springs of California,' on which some of the data below are based. None of the water from the springs is bottled at the present time, although some of it is reported to have a therapeutic value.

California Hot Springs. The springs are located on the west bank of Deer Creek, just within the southwestern boundary of Sequoia National Forest, twenty-seven miles east of Ducor and thirty-five miles southeast of Porterville. Elevation is 3200 feet.

The springs issue from seams in coarse-textured gray granitic material, which is the country rock of the region. There are several springs issuing at points along Deer Creek Canyon, with temperatures ranging from 105° to 126°. The waters are not highly mineralized, but principally primary alkaline in character, and noticeably sulphureted. Analysis shows a large proportion of lithium chloride, di-sodium arsenate, and sodium meta-borate. The waters are reported to be effective in the treatment of anemia, malarial poisoning, neuralgia, scrofula, rheumatism, rheumatic tendencies and gout.

There is a large hotel, annex, and numerous furnished cottages for accommodations. A large bathhouse is conveniently located near the hotel, as well as store, post-office and garage. Mrs. E. H. Williams, owner and manager; J. H. Williams, secretary and assistant manager. An analysis of the water by Curtis and Tompkins, San Francisco, April 3, 1928, on sample marked No. 1, Temp. 125° F., shows:

HYPOTHETICAL FORM OF COMBINATION

	Grains per gal.	*Pts. per million*
Ammonia chlorid (NH_4Cl)	0.26	0.45
Lithium chlorid ($LiCl$)	0.032	0.55
Potassium bromide (KBr)	----	Trace
Potassium iodide (KI)	----	Trace
Potassium chlorid (KCl)	0.187	3.2
Sodium chlorid ($NaCl$)	2.863	49.1
Sodium nitrate ($NaNO_3$)	0.043	0.73
Sodium tetraborate ($Na_2B_4O_7$)	1.166	20.00
Di-sodium arsenate ($Na_2H.AsO_4$)	0.001	0.02
Sodium sulphate (Na_2SO_4)	**0.554**	**9.5**
Calcium phosphate ($Ca_3(PO_4)_2$)	----	Trace
Sodium carbonate (Na_2CO_3)	2.473	42.4
Sodium bicarbonate ($NaHCO_3$)	3.172	54.4
Magnesium bicarbonate ($Mg(HCO_3)_2$)	0.176	3.0
Calcium bicarbonate ($Ca(HCO_3)_2$)	0.426	7.3
Ferrous bicarbonate ($Fe(HCO_3)_2$)	0.128	2.2
Silica (SiO_2)	3.266	56.0
Totals	14.512	248.85

SANITARY ANALYSIS

	Pts. per million
Free ammonia	0.138
Albuminoid ammonia	0.106
Nitrogen as nitrates	0.12
Nitrogen as nitrites	None

GASES (AT 0°C AT 760 MM PRESSURE)

Hydrogen sulphide	None
Free carbon dioxide	None
Carbon dioxide (set free from bicarbonates on evaporating to dryness)	9 cc per liter

Bibl: State Mineralogist's Report XV, pp. 941–943; XVIII, p. 535. U. S. Geol. Survey Water-Supply Paper No. 338, 'Springs of California,' pp. 49–50.

Coburn Soda Spring. This spring is located at Springville, on the north bank of the North Fork of Tule River, at an elevation of 1000 feet. The spring rises from a fissure in the granite and the water has a temperature of 68° F. Much gas continually rises with the water, which is moderately carbonated and stains its run-off channel with iron. It is a rather strongly mineralized water, secondary alkaline and primary saline in character.

Bibl: State Mineralogist's Report XV, pp. 943–944. U. S. Geol. Survey Water–Supply Paper 338, pp. 241–242.

Doyle Soda Springs. This group of carbonated springs is on the North Fork of Middle Fork of Tule River, 13 miles northeast of Springville. Considerable iron stain is near the spring vents. A small amount of carbonate of lime or magnesia is also deposited by the spray from the two main springs, but the water is probably not highly mineralized. All the carbonated water probably issues from the gneiss, which seems to form a belt in the granitic rock.

Bibl: State Mineralogist's Report XV, p. 944. U. S. Geol. Survey Water–Supply Paper 338, p. 242.

Jordan Hot Springs. About 14 springs issue in a little flat along the banks of Nine Mile Creek, three miles east of Kern River, and twenty miles south of Mt. Whitney. The elevation is 6600 feet. The springs have formed prominent deposits of lime carbonate, and the water is noticeably hard. The principal springs range in temperature from 95° to 123° F. and yield from 1 to 10 gallons a minute. Jordan Hot Springs rise through lime-cemented, granitic gravel, and the surrounding slopes are of granitic rocks. Three or four miles northward, however, there is some lava, and it is mentioned by Waring[1] that it was not noted in the immediate vicinity of the Jordan Springs, but its presence near the lime carbonate deposits at Natural Bridge and in Kern River Canyon suggested that the presence of carbonates or bicarbonates and free carbon dioxide in the water of Jordan Hot Springs was in some way related to lava rocks.

A pleasure resort is located at the springs, and is reached by trail from Camp Nelson or from Oaks, near Olancha, Inyo County.

Bibl: U. S. Geol. Survey Water–Supply Paper 338, pp. 53–54.

Little Yosemite Soda Spring. It is near North Fork of Kern River, about two and one-fourth miles north of Kern Lake and 65 miles north of Kernville, Kern County, in Kern National Forest. The water (51° F.), is strongly carbonated and deposits considerable iron. Analysis shows that the water contains only a very moderate amount of solids in solution, being essentially primary and secondary akaline in character.

Bibl: State Mineralogist's Report XV, p. 944. U. S. Geol. Survey Water–Supply Paper 338, pp. 244–245.

Lloyd Meadows Springs. It is situated in Lloyd Meadows, within Sequoia National Forest; on the banks of Freeman's Creek, about 42 miles northeast of Porterville and about 9 miles east of Camp Nelson by trail. This small, cool, carbonated spring is used by campers as a drinking spring.

[1] Waring, G. A., Mineral Springs of California; U. S. Geol. Survey, Water-Supply paper 338, 1915.

Nelson's Soda Springs. Camp Nelson, C. B. Smith, proprietor. Four carbonated springs rise on the property of this mountain resort, located on the north bank of the South Fork of the Middle Fork of Tule River, 15 miles east of Springville. Elevation is 4650 feet. The springs rise in a region of granitic rock, but on the slopes above them are ledges of limestone that may account for the apparent high amount of calcium in their waters. The limestone appears, possibly as included masses in the granitic rock. The temperature of the carbonated springs ranges from 62° to 69° F.

Bibl: State Mineralogist's Report XV, p. 945. U. S. Geol. Survey Water–Supply Paper 338, pp. 243–244.

Soda Spring on Middle Fork of Tule River. A small carbonated spring is situated on the northern side of Middle Fork of Tule River, about six miles east of Springville and one and one-half miles below the junction of the two main branches of the Middle Fork. Elevation, 2400 feet. Besides being moderately carbonated; the water tastes faintly of hydrogen sulphide.

Bibl: State Mineralogist's Report XV, pp. 944–945. U. S. Geol. Survey Water–Supply Paper 338, p. 242.

Soda Spring in Monache Meadow. Warm sulphurated carbonate springs rise in Monache Meadows, near the South Fork of Kern River, about 14 miles by trail southwest of Olancha. Elevation, 8000 feet. It issues near the eastern base of Monache Mountain, a rhyolite mass that towers above the meadow.

Bibl: State Mineralogist's Report XV, p. 945. U. S. Geol. Survey Water–Supply Paper 338, p. 246.

Soda Spring near Quinn Horse Camp. Quinn Horse Camp is in the southeast end of the Sequoia National Park, about 9 miles in a direct line west of Kern Lake, but 16 miles by trail over Coyote Pass, and 71 miles northeast of Porterville. Near Soda Creek, which heads near the camp, there is a carbonated spring of considerable flow that is known to travelers over the trails in this region.

Bibl: State Mineralogist's Report XV, p. 945. U. S. Geol. Survey Water–Supply Paper 338, p. 245.

Soda Creek Spring. About 150 yards above the Nelson Camp trail there is a carbonated spring on Soda Creek, 9½ miles east of Springville. The spring issues from granitic boulders at the eastern side of the creek. The water is strongly carbonated, tastes sweetish and deposits iron, but a noticeable amount of lime carbonate was not seen.

Bibl: State Mineralogist's Report XV, p. 945. U. S. Geol. Survey Water–Supply Paper 338, p. 243.

Soda Spring. This carbonated spring of unusually large flow rises on the northern side of the South Fork of Middle Fork of Tule River, about two miles above the junction with the North Fork. It is in the Sequoia National Forest Reserve, eight miles east of Springville. The water is warm, strongly carbonated, and tastes faintly sweetish, probably of iron. A deposit of lime carbonate that is much iron-stained extends to the river's edge.

Bibl: State Mineralogist's Report XV, pp. 945–946. U. S. Geol. Survey Water–Supply Paper 338, pp. 242–243.

Soda Spring in Upper Funston Meadow, is about 13 miles by trail northward from Kern Lake, on a plateau lying between two branches of Kern River, about 69 miles northeast of Porterville, in Sequoia National Forest Reserve. The water is cool, moderately carbonated, and seems to be similar in character to the one near Kern Lake.

Tule River Soda Spring. The spring is situated on the Tule Indian Reservation, 16 miles east of Porterville, at the north edge of the South Fork of Tule River. The spring issues beneath a large granitic boulder, from crevices in gneiss that is similar to the rock at Doyle Soda Springs. The water is moderately carbonated and deposits considerable iron.

Bibl: State Mineralogist's Report XV, p. 946. U. S. Geol. Survey Water–Supply Paper 338, p. 244.

MOLYBDENUM

Two deposits of molybdenum are reported to be close to the highway, about 15 miles east of Ducor on the road to California Hot Springs, on patented land.

Kaweah Molybdenum Mines Company. Edwin Letts Oliver, president; L. V. Riddle, secretary; home office, 619 Crocker Building, San Francisco.

Sixteen unpatented claims and one mill site in the Mineral King district, T. 25 S., R. 31 E., are owned by this company. Average elevation of the claims is about 9500′. An adequate water supply is available, while sufficient timber may be found within a distance of two miles. The deposit was discovered in 1916 and is reported to be a wide dissemination of molybdenite of good grade in granite. Development work consists of the annual assessment work each summer.

Bibl: State Mineralogist's Report XVIII, p. 47.

NATURAL GAS

Natural gas occurs in many of the water wells drilled in the Tulare Lake region. The gas has not been utilized commercially except for local domestic use on several of the ranches, where it is used to run the pumps and for heating, lighting, and cooking. Analyses from a previous report [1] show the gas to be swamp gas or 'marsh' gas, which is essentially methane, CH_4. It is perfectly odorless and burns with an uncolored flame. Many comparatively shallow wells were drilled in the region from 1917 to 1922 in an attempt to produce oil or gas in commercial quantities and failed.

Among the numerous ranches reported to have gas wells are: F. E. Crowell Ranch, three miles southwest of Alpaugh; Bent Ranch, south of Crowell Ranch; J. Akes Ranch, 10 miles southwest of Alpaugh; N. G. Rising Ranch, (Golden State Property); Holland Dairy Ranch; R. Y. Williams Ranch (Fulton); California Natural Gas and Development Co's. property, five miles southwest of Angiola, Bob Schmizer; E. L. Fox Ranch (Percival), four miles south of Angiola; Tulare Farms property; Dan Gregg lands, south of Alpaugh; and Canfield

[1] Barnes, R. M., A Preliminary Report on the Tulare Lake Region: Annual Report of the State Oil and Gas Supervisor, Vol. 8, No. 1, July, 1922.

Ranch, E. C. Percival & Son, Angiola, managers. For additional information on these gas wells see Report XVIII of the State Mineralogist, pp. 535–537, and others mentioned in the following bibliography.

Bibl: State Mineralogist's Report XI, p. 486, XVIII, pp. 535–537; Bull. 3, pp. 20, 68; Bull. 19, p. 183; Bull. 69, p. 118; Bull. 89, pp. 177–178. Summary of Operations, Calif. Oil Fields, Vol. 5, No. 6; Vol. 8, No. 1. U. S. Geol. Survey Bull. 398; Water–Supply Paper 398.

Discovery well of Terra Bella Oil Company, Gardner No. 1, Tulare County.

Sierra Nevada Mts.
E.
Possible Oil Field
San Joaquin Valley
Granite
Valley Soil
Pliocene
Miocene Shale
Oligocene
Eocene
Cretaceous
Coast Range
W.
SECTION A-B
Sierra Nevada Mts.
E.
Possible Oil Field
San Joaquin Valley
Granite
Valley Soil
Possible Oil Field
Proven Oil Field
Pliocene
Miocene Shale
Eocene
Coast Range
W.
SECTION C-D'

PETROLEUM

Newspaper reports (Sept. 15, 1930) show that there are thirteen operators in action on 15 projects near Terra Bella, in Tulare County. One of this group is a producer, six are drillers, while the balance are in the predrilling stage or nondrillers.

The discovery well, Gardner No. 1, of the Terra Bella Oil Company, is located in Sec. 35, T. 22 S., R. 27 E., near Porterville. The well is down 918 feet and has had considerable trouble with water, pumping from around 25 to 60 barrels of oil and about 75 to 100 barrels of water. The gravity of the oil is reported as 17.3°. Whether the oil is in commercial quantities and the water shut off is possible, remains to be seen.

Excerpts from Bulletin 89, "Petroleum Resources of California," printed in 1921, relative to this vicinity, states:

"As stated above, the chief hope of finding new fields in the San Joaquin Valley lies in the possibility of locating structures which are buried beneath the surface soil of the valley. One such fold was discovered when the Belridge field was found productive. At the present an area around Buttonwillow, which apparently shows some evidence of containing a buried anticline, is being tested and with encouraging results to date, such as quantities of gas and small showings of oil. As stated above, there is little or no evidence of these buried structures on the surface, in the form of outcrops of rocks or low hills, such as mark the already proven areas. The chief surface evidence that might be present would be slight elevations and ridges that rise above the dead level of the valley floor. Also some evidence might be furnished by water wells and prospect holes.

"It is evident that these folds will be found only by a close study of the topography and logs of water wells within the region in which they are likely to occur.

"The general area in which the writer believes these structures are likely to be found in the San Joaquin Valley is in the districts referred to above as being underlaid by the organic shale beds of the Kreyenhagen, Monterey and Santa Margarita formations, namely an area along the west side of the valley, running from the vicinity of the northwestern boundary of Stanislaus County southward to Tulare Lake, and a second area comprising the entire floor of the valley lying south of Tulare Lake. In the first area the oil would be formed from the Kreyenhagen shale and collect in the Vaqueros sandstone. In the second area the oil would form in the Miocene shales and collect in the McKittrick beds. The cut shows two hypothetical sections across the valley. Section A-B in the region north of Coalinga and Section C-D in the area south of Tulare Lake. These two sections show the possible source and reservoir beds in each district, as well as two kinds of possible accumulation—a possible anticlinal fold, shown in the left half of the sections, and in the right half a possible monoclinal structure along the old shore line of the sea in which the diatomaceous shales were deposited, and where the oil might accumulate by reason of a possible overlap of the reservoir bed of the upturned edges of the shale.

"These two areas have been shown on Plate I (Bulletin 89), colored in blue, as possible oil land. This does not mean that oil fields are going to be found over this entire region, or for that matter, that any will be found. It simply indicates that within this region there is a fairly good chance that buried productive structures may be found."

* * * * * * *

"In the flat valley area lying out in front of these hills (meaning foothills of the San Emigdio and Tejon regions) and extending north to Tulare Lake, there are no surface indications of petroleum. However, the outcrops in the foothills that surround this portion of the valley on three sides indicate that it is underlaid by the Miocene diatomaceous shale, and the reservoir beds of the McKittrick formation, and, as stated in the article on 'Buried Structures,' it may possibly contain anticlines which may prove productive. Section C-D is a hypothetical section across this portion of the valley, and shows how possible oil-bearing structures may exist."

* * * * * * *

"At Terra Bella the Pliocene beds which continue on north to this point from the Kern River area disappear, and from this point north to the region east of Madera, the valley soil rests directly against the crystalline rocks of the Sierra Nevada. Evidence of the presence of sedimentary rocks is lacking, and it is probable that the granite is present at shallow depths beneath the surface sand over a great portion of this region."

* * * * * * *

"In the low marshy area around Tulare Lake gas has been obtained for a number of years from shallow water wells, and recently some deep wells have been drilled which showed large quantities of gas at depths below 2000 feet. In no case, however, has the State Mining Bureau been able to verify any of the reported oil showings. The gas encountered resembles strongly the 'marsh gas' obtained in the wells around Stockton and Sacramento. It is perfectly odorless and burns with an uncolored flame. As yet there is no evidence that this gas is connected with any petroleum deposit. The surface in this region is flat and covered with valley alluvium and soil which gives no evidence as to what is beneath it. This portion of the valley, however, falls within the area that may possibly contain buried anticlinal folds, and it is possible that the gas found here has accumulated by reason of such a fold.

Whether or not it would contain petroleum, or actually exists, can only be told by drilling."

Bibl: Oil Bulletin, Vol. XVII, No. 1, pp. 14–17, 76. Also see biliography under 'Natural Gas.'

RHODONITE

Janoiko Brothers. Frank and George Janoiko, R.F.D. No. 1, Box 688, Porterville. Deposits of rhodonite, feldspar and rose quartz are reported by the above.

SILICA

Guthrie Silica Deposit. H. W. Guthrie, White River, owns a silica deposit, the vein outcropping for about one-half mile, with quartz crystals.

Miner's Silica Deposit. H. H. Miner, Sanger, California, has several deposits of quartz-silica and rose quartz in Tulare County, in the vicinity of Worth and Success.

Skid Road No. 1 Claim. A. P. O. Crabtree, Porterville, owner. This deposit of silica is reported to be three-fourths mile from a truck road, near Mountain Home, at the foot of Mt. Moses, northeast of Porterville.

SILVER

Deer Creek Silver Mine. This old property was worked in the 60's or 70's, the ore at that time being hauled by wagon to Tipton for shipment to the smelter. In August, 1922, the Deer Creek Silver Mining Co. (not incorporated), 1330 L street, Bakersfield, Cal., acquired and reopened the mine. At present it is idle.

The mine is situated 11 miles south of Porterville, six miles from Magnolia Siding, the nearest rail-shipping point. Terra Bella is the nearest town. The elevation is from 500–600 feet. The deposit occurs in a sheer zone about 150 feet wide, containing several parallel igneous dikes, and consists mainly of a quartz vein system with talc gouge and cross veins. The country rock, granite, forms both foot and hanging wall. The vein strikes N.–S. and dips about 50° W. The ore carries silver sulphides, some gold, and about 6% copper in the form of azurite. Development consists of several shafts, drifts, and crosscuts.

Bibl: State Mineralogist's Report XVIII, pp. 537–538.

SOAPSTONE AND TALC

E. A. Orton Property. E. A. Orton, Lindsay, owner. This talc deposit is located three miles east of Lindsay in the Elephant's Back Hills. Shipments of several tons have been made from this deposit in the past. The talc does not grind white.

A deposit of soapstone is reported to exist on the *Fred Gill Property* in Yokohl Valley, 9 miles east of Exeter. This deposit was worked some, prior to 1912.

STONE INDUSTRY

F. W. Blaine Property. Concrete pipe is manufactured, using local sand and Fresno County gravel. A concrete mixer, gasoline engine and molds are used. Location, Tulare.

Brown Cement Works. D. C. Brown, R.F.D. 3, Box 343 A, Tulare, owner. Plant two miles east of Tulare. Sand used is on property. Equipment includes a K. T. concrete mixer, gas engine, Conco brick machine and Hobbs block machine. Concrete pipes and brick are manufactured.

Carr Crushed Rock Co. W. S. Carr, Lindsay, owner. A portable rock crushing plant, capable of producing about 16 tons of crushed rock per day, has been erected 8 miles northeast of Lindsay on the Roeding Ranch. A pile of boulders are the source of supply, and five grades of crushed blue stone are produced. Equipment consists of crusher, belt conveyor, screens, and a 15-h.p. electric motor.

County Rock Pit. The county has a 7-acre decomposed granite pit about 14 miles northeast of Porterville. The rock is loosened by blasting, and then loaded on trucks and railroad cars by an Erie steam shovel. The Springville branch of the Southern Pacific Railroad crosses the property. The deposit is worked only a few months each year.

County Sand Pit. The county operates a sand pit near Venice Cove, on the Klink Road.

Duggan and Nelson. J. J. Duggan and J. Nelson, Porterville, own a concrete pipe works in the western portion of the city. Sand and gravel are obtained from the Tule River. A K. I. cement mixer, portable mixer, and a Herr pipe machine are among the equipment. Electric power is used.

Garland Sand Pit. E. Garland, owner. Pit located about three miles east of Visalia. G. A. Bigard, Visalia Transfer Co., Visalia, hauls sand from pit for local uses.

Lindsay Cement Products Co. P. M. Porter, Lindsay, owner. Local sand is used while the crushed rock is secured from Fresno County. The concrete pipe is cured in the sun by sprinkling. Equipment includes a Johnson pipe machine and four cement mixers. Electric power is used.

McWilliams Sand Pit. Located one mile northeast of Visalia.

Meling Concrete Pipe Works. K. A. Meling, Lindsay, owner. Local sand is used, while the crushed rock is secured from Fresno County. Equipment consists of a Blystone concrete mixer, portable mixer, and a Herr pipe machine. Electric power is used. About five men are employed nine months of the year to manufacture concrete pipe, used for irrigation on the numerous orchards in this vicinity.

G. G. Noble Property. Guy G. Noble of Tulare has a concrete materials plant in town where concrete blocks and staves are manufactured. Most of the sand and gravel is obtained from near Friant, Fresno County, although some local sand and gravel are used. Equipment consists of a Clayford concrete stave machine, Keller–Thompson concrete mixer, gasoline engine, and a 3-h.p. motor.

Porterville Cement Pipe Co. Bob Jurkovich, Main and Date streets, Porterville, owner. Sand and gravel are secured out of the Tule River. Equipment includes a Blystone mixer, portable Yaeger mixer, Herr pipe machine and molds. Electric power is used. Concrete pipe from

6″ to 36″ in diameter is made. About 16 men are employed half the year and four the remainder.

F. O. Sheldon Co. It is reported that a sand and gravel plant is to be constructed upstream from the Santa Fe bridge on the Tule River by the above company of Porterville.

L. S. Sheppa Concrete Brick Works. L. S. Sheppa, owner. Plant located about a mile northwest of Tulare. Equipment includes an electric concrete mixer and a Conco brick machine.

Rem Tonken Concrete Pipe Works. Rem Tonken, Tulare, owner. Local sand, one and one-half miles east of Tulare, is used; while gravel is secured from Fresno County. Equipment consists of a concrete mixer, Herr pipe machine and molds necessary to manufacture concrete pipe and brick. Electric power is used. Three men are employed when the plant is operated, which is only a portion of each year.

Tulare Cement Pipe Co. S. O. Segeda, Tulare, in charge. Local sand is used. Equipment includes an electric concrete mixer and Johnson pipe machine. The plant is operated only a portion of the year, when about eight men are employed. Concrete pipes and blocks are made.

Tulare Rock Co. O. Holliday, Lindsay, foreman. This gravel plant is located five miles southeast of Lindsay, across from the Universal Silicate Stucco and Lime Products Corporation's kiln. The plant was in the course of construction when visited. The property comprises 40 acres, which is underlain by an estimated 15 feet of gravel. A dragline scraper will be used to mine the deposit. Equipment will consist of jaw and gyratory crushers, and Gilbert screens. Six grades of rock and two of sand are expected to be produced. Electric power will be used.

Van Cleve Construction Co. J. A. Van Cleve, president; P. H. Van Cleve, secretary. Plant is four miles northeast of Exeter, about a quarter of a mile north of the Visalia Electric Railroad. Local sand is trucked in from a branch of St. Johns River, while gravel is secured from Fresno County. Rock dust from the Kaweah Quarries is used in making the mix. Equipment consists of a McCracken pipe machine, two Blystone cement mixers, and two portable mixers. The concrete pipe is cured by eight day continuous sprinkling. The capacity of the plant is 2500 feet of concrete pipe daily. Electric power is used. An average of 15 men are employed.

TUNGSTEN

Kennedy Tungsten Mine. J. H. Kennedy, Posey (Jack Ranch); W. A. Trout and M. G. Brumley of Los Angeles, owners. This mine is located two miles southeast of Jack Ranch or 39 miles southeast of Porterville. Elevation about 4700 feet. Holdings comprise three claims: Broad Horn, Big Bear, and Evelyn. Timber: Oak and mahogany.

Frank Ellis had prospected this property prior to Mr. Kennedy's development, which began in July, 1929. In April, 1930, actual work was started on the property and at the time of visit, July, 1930, a mill was almost completed. The ore occurs as scheelite in a garnetiferous

gangue, between a granite footwall, and a schist and blue-limestone hanging wall. The deposit strikes NW.-SE., dipping westerly.

Development consists of a 75-foot tunnel crosscutting the vein and a 32-foot drift on the outcrop. At a depth of 15 feet there is a 40-foot drift. About 500 feet has been proven on the surface. The ore is to be trammed from the mine down to a 50-ton storage bin at the mill, just below the mine. Equipment consists of a grizzly, 60-ton Universal crusher, 20-ton Hammon ball mill, two Myers service tables for desliming, and two 16-foot Standard Overstrom tables. A 2-inch pipe, 2500 feet long, is used to pump water up to the mine. Water is secured at 60 feet, and a Fairbanks–Morse pump jack, Rumsey (5 by 6) Booster Triplex, and a 10-h.p. Fairbanks–Morse engine are used in pumping. About ten men are to be employed.

Another tungsten claim, the *Anita May,* with about 140 feet of tunnel, is located below the above property.

Van Cleve Construction Company's concrete pipe plant, four miles northeast of Exeter, Tulare County.

ZINC–LEAD

Valuable deposits of lead and zinc ores, with some copper and silver values, occur in the Mineral King and Camp Wishon districts.

The *Mineral King Mining District* is situated near the headwaters of the Middle Fork of Kaweah River, 37 miles northeast of Lemon Cove, and 60 miles northeast of Visalia. The Visalia Electric Railroad has a terminus at Lemon Cove. This highly mineralized district is located in T. 17 S., R. 31 E. Mineral King village is in the bottom of a deep canyon, at an elevation of 7830 feet.

The Mineral King mining district was discovered on August 26, 1873, by J. A. Crabtree, A. Luke, and S. Belden, of Porterville. Ore was first discovered on the White Chief claim, which is about two and one-half miles south of Mineral King. There was a rush to this district in 1879–1880, during the silver excitement. Only intermittent

attempts at mining have been made in the district, due to the complex character of the ores and the inaccessibility and distance from transportation. However, the road to Mineral King has been improved in the last few years, and is now a good mountain road.

In 1875 the Empire Mine was opened up, and a tramway and 10-stamp mill operated for a short time, in an attempt to extract the silver values from the ores by amalgamation, but with poor success. The mill and tramway have been carried away by snowslides. The McGinnis, Empire, Lady Franklin, White Chief, and Silver Lake claims carry good lead and zinc values.

The following are excerpts from Knopf and Thelen's[1] report:

"Mineral King is situated on the headwaters of the East Fork of the Kaweah River near the western crest of the southern Sierra Nevada. This portion of the range is known as the High Sierra, and is preeminently distinguished by the sharply serrate character of its profiles and the vast assemblage of lofty peaks. Of these none illustrate more impressively the peculiar felicity of the term 'Sierra Nevada' than does Sawtooth, under whose shadow Mineral King lies. Mineral King occupies very nearly the north center of a narrow belt of sedimentary rocks, now more or less schistose, some 14 miles long and 2 miles wide, and striking NNW. This area of stratified rocks represents an isolated remnant of the extensive terrane into which the Sierran batholithic magmas were intrusive during Mesozoic time. The hypsometric relations disclose the fact that the schists are deeply sunk into the granites, and make it obvious that their preservation is in large part due to this favoring circumstance. The belt has been strongly mineralized, whence its name, and has invited a large amount of prospecting, but exploitation has not proved profitable. The region was traversed by Professor Lawson in his physiographic reconnaissance of the upper Kern Basin, and its salient features outlined and discussed in concise form."

* * * * * * *

"It has been pointed out that the sedimentary rocks form an elongated belt surrounded by granites. The vigorous erosive activity has laid bare the contact at numerous points and has revealed clearly the intrusive nature of the plutonic rocks.

"Porphyritic modifications, and in one instance, a rude gneissic structure, are occasionally developed as marginal facies. The porphyritic modification is best displayed at the upper Monarch Lake. The granite, here a coarse quartzose microcline granite of normal hypidiomorphic habit, is converted at the contact into a closely crowded assemblage of microcline phenocrysts embedded in a fine-grained mesostasis consisting of quartz and small flakes of biotite. A similar modification is found on the western side of the belt in the White Chief Cirque.

"The irruptive is accompanied by extensively ramifying systems of apophyses, which are, however, never very long. The longest found was 20 feet thick and followed the strike of the schists nearly a thousand feet. The larger veins, as a general rule, cut across the schistosity at random, but the anastomosing system of capillaries to which they give rise, tend to seek out the planes of weakness. Their fineness, and acutely serpentine character, argue a great degree of fluidity for the intrusive magma.

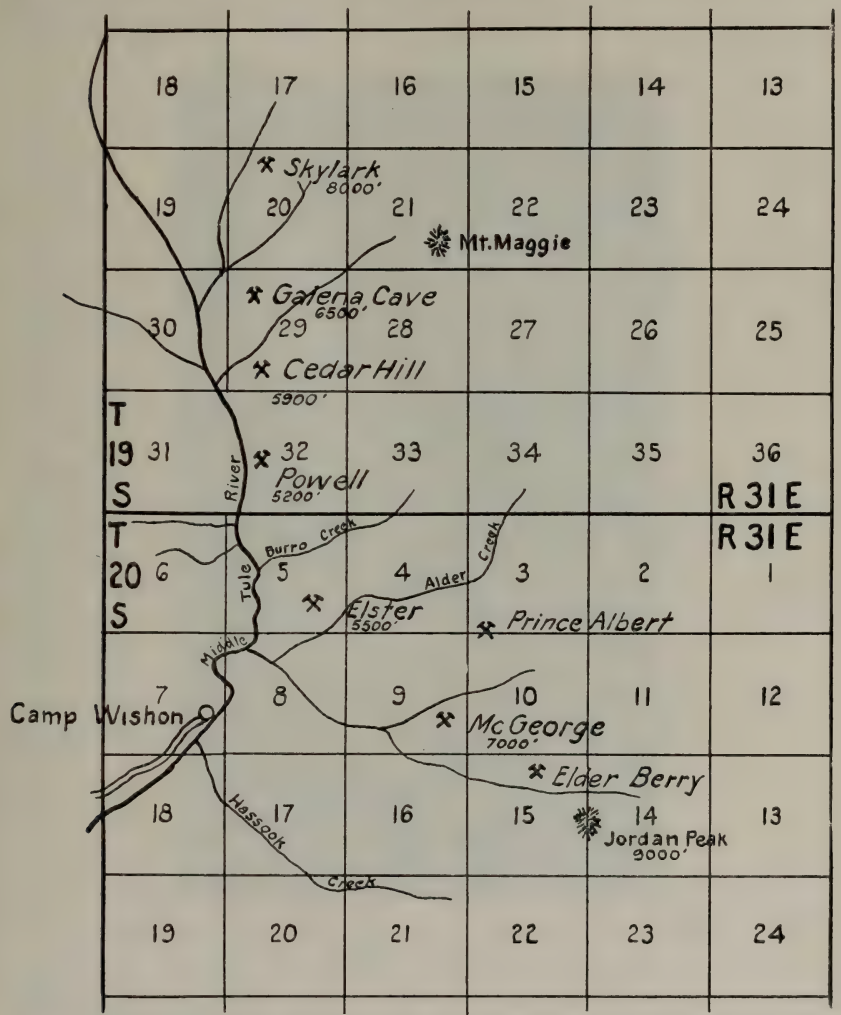
"In addition to the thermal metamorphic influence of the granite, it has at points been active dynamically also. West of the Timber Gap, the irruptive has locally bent the schists from N. 45° W. around to N. 25° E. and back again to the normal strike. Extensive shattering of the strata, especially in the Silver Lakes region, has taken place, but the results are complicated by the internal movements which the belt has undergone.

"The granite at the contact frequently contains included large numbers of angular fragments of schists. Occasionally they show some rounding of the edges, and even embayment, or may be surrounded by a resistant aureole which causes them to weather in relief. Aplite dykes and pegmatites are common at the contacts and vicinity, and were noted to fault from two or three inches the basic segregations previously described."

The granite of the region varies a great deal in character, some of it being porphyritic, with large crystals of feldspar, and it is frequently traversed by veins of quartz and feldspar. All of the mines lie in a belt of very highly metamorphosed calcareous slates and siliceous limestones which strike N. 30° W. and dip southeast at high angles varying from 60° upwards. There are complex sulphides of copper, lead, and zinc associated with arsenopyrite carrying silver values found in this belt of crystalline limestone which seem to be irregularly distributed through the slates. These ores usually occur on contact of the limestone with slate or granite.

[1] Knopf, A., and Thelen, P., Sketch of the geology of Mineral King, California, University of California, Geology Dept., Vol. 4, No. 12.

The *Camp Wishon district,* which is reached by a good mountain road through Springville, lies at an elevation of 4200 feet. It is 30 miles northeast of Porterville, and there is a control on the road from Coffee Camp to Camp Wishon. Most of the mining claims are located north and east of Camp Wishon. The country rock consists mainly of metamorphosed sedimentary rocks and intrusive quartz-diorites.



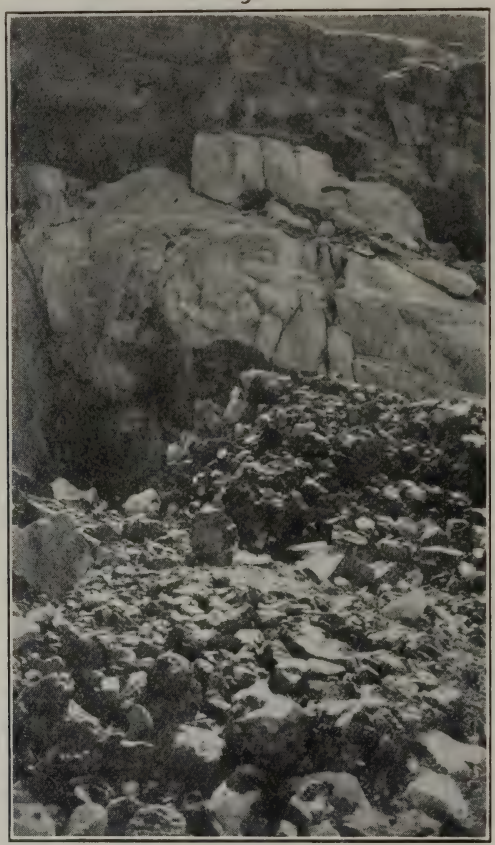
Approximate location of mines in the Camp Wishon copper-lead-zinc region, Tulare County.

The ore is found along the contact of the metamorphosed limestone and the quartzites, schists, and diorite. The ores are chalcopyrite, sphalerite, pyrrhotite, associated with iron sulphides, carrying some gold and silver values. There are many shallow workings in the region which expose good ore.

Empire Mine. Arthur Crowley, Mineral King and Visalia, owner. The Empire Mine was discovered in 1875, and worked until 1880, when

operations were suspended on account of the complex character of the ore. The property is located one mile northeast of Mineral King, at an elevation of 10,400 feet, on the south slope of Empire Mountain. Holdings comprise three claims: Empire Discovery, First Extension North and South, and the Empire Extension North (patented) claim.

The ore consists of sphalerite associated with some galena, and arsenopyrite in a calcite gangue. The ore occurs on the contact of limestone, granite, and a metamorphic slate. Early workings consist of



Zinc-lead mine in White Chief group of claims, Mineral King, Tulare County.

several shafts and tunnels, some of which are now caved in. There have been no recent developments, except for assessment work.

Bibl: State Mineralogist's Report VIII, p. 645; XV, p. 950; XVIII, p. 538. University of California Publications, Geol. Dept., Vol. 4, No. 12, pp. 227–262, Turner, H. W. (Am. Geologist, vol. 13, p. 231, 1894; U. S. Geol. Survey Fourteenth Ann. Rept., pt. 2, p. 451).

Lady Franklin Mine. T. J. Crabtree, Mineral King and Porterville, owner. This property, consisting of two claims, Lady Franklin and Mohawk, is situated one and one-half miles southeast of Mineral King,

on slope of ridge south of Lady Franklin Canyon, at an elevation of 9800 feet. The claims are in Sec. 25, T. 17 S., R. 31 E. The ore contains lead, zinc, and arsenopyrite with traces of copper, and some antimony sulphide ore in places. It is found in a belt of thin bedded limestone inter-calcated between the slates, which strike about N. 50° W., and dip at 70° NE. Development consists of several prospect shafts and tunnels. Assessments only.

Bibl: State Mineralogist's Report VIII, p. 647; XV, p. 951.

McGinnis Group of Mines. W. F. Cord, Mineral King and Ducor, owner. This group is located about one and one-half miles northeast of Mineral King, on ridge north of Monarch Canyon, at an elevation of 10,600 feet. The claims consist of the San Jose, McGinnis, Park, Mankin, and Aida V.

Metamorphic slates and granites distributed with crystalline limestone occur; with the ore-bearing zone along the contact, accompanied by an epidote dike. The ore is a complex lead-zinc sulphide, with an epidote gangue. The San Jose McGinnis vein strikes N. 45° W., with a dip of 75° SW. Developments consist of quite a number of shafts and short tunnels along the outcrop of the vein. Recent exploration consists only of the annual assessment work.

Bibl: State Mineralogist's Report XV, pp. 591–592.

Sequoia Silver–Lead Mine. C. T. Williams, owner. Situated several miles northwest of Mineral King, on the East Fork of Kaweah River. Timber consists of pine, spruce and fir. Holdings comprise seven claims. A tunnel has been driven in about 45 feet, at an elevation of 7500 feet. The mineralized zone above the tunnel is reported to run from 7 to 30 feet wide in the lime, which is bordered by schist to the east, and gneiss and granite to the west. The strike of the strata is almost N.–S., and the dip is nearly vertical.

The old *Dolly Varden Mine* is included in these claims and is situated on the ridge between Eagle Lake and Mosquito Lake cañons, at an elevation of 10,000 feet. The ore at the Dolly Varden Mine occurs on a fault fracture which has been filled with quartz that is highly mineralized with lead-zinc sulphides and contains high silver values.

The group consists of the *Comanche Mine,* which is about one and one-half miles southwest of Mineral King in Sec. 22, T. 17 S., R. 31 E., northwest of the Dolly Varden Mine, at an elevation of about 9600 feet. The ore is reported to be a zinc sulphide in an epidote gangue.

Several other old shafts, down from 10 to 30 feet, are on the property. Equipment consists of portable blacksmith forge, hand tools, etc. Assays of ore submitted by Williams to Ed. Eisenhauer, Jr., Los Angeles, show:

Sample from	*Gold*	*Silver*	*Lead*	*Zinc*	*Cadmium*
10 ft. shart	0.04 oz.	4.0 oz.	12.0%	18.7%	-----
30 ft. shaft	0.02 oz.	4.7 oz.	22.8%	24.6%	0.26%

Bibl: State Mineralogist's Report XV, pp. 949–950; XVIII, p. 538. University of California Publications, Geol. Dept., Vol 4, No. 12, pp. 227–262.

Silver Lake Zinc Mine. T. J. Crabtree, Mineral King and Porterville, owner. It is situated two miles southeast of Mineral King, on

the slope of ridge north of Lower Franklin Lake, at an elevation of 10,600 feet. Ore occurs on limestone and granite contact, running N. 30° W., and also along an epidote dike which cuts a wide belt of coarse crystalline limestone. The ore is largely sphalerite and the gangue material is hornblende, epidote, and siliceous limestone. Several shallow open cuts expose the zinc sulphide ore.

Bibl: State Mineralogist's Report XV, p. 593.

White Chief Mine. T. J. Crabtree, Mineral King and Porterville, owner. This property is located 2½ miles south of Mineral King, in Sec. 31, T. 17 S., R. 31 E., in White Chief Canyon. Elevation is 10,000 feet. Holdings comprise three claims, one of which (Luke) is patented. The White Chief claim was the original discovery of ore in the Mineral

Limestone mass, bordered by zinc-lead vein to extreme left, near White Chief group of claims, Mineral King, Tulare County.

King district, in 1873. Smelting of the complex ores from this claim was attempted in 1879 and 1880, with poor success.

An old tunnel 195 feet long crosscuts through 150 feet of solid marble and the last 45 feet to the face runs through granite. The limestone belt strikes N. 35° W., its southwest wall being granite, while the northeast walls are slates standing nearly vertical. The surface contact between the limestone and the granite dips very steeply to the southwest, and here in the limestone is where the complex ores are found. Galena and sphalerite, carrying silver values, form the chief ore; which shows a width of 6 to 8 feet on the contact. Workings consist of a number of shallow open cuts and several shafts down from a few feet to 100 feet. When visited in July, 1930, assessment work was being done on an open cut.

Bibl: State Mineralogist's Report VIII, p. 646; XV, pp. 593–594. University of California Publications, Geol. Dept., Vol. 4, No. 12, pp. 227–262.

Other zinc-lead properties in the Mineral King district are:

Chihuahua Mine, situated on ridge between Lake and Rock Gorge cañons, two miles east of Mineral King in Sec. 13, T. 17 S., R. 31 E., at an elevation of 10,500 feet. Idle.

Bibl: State Mineralogist's Report XV, p. 949.

Crystal Prospect is two miles northeast of Mineral King in Lake Cañon, at an elevation of 10,000 feet. Idle.

Bibl: State Mineralogist's Report XV, p. 949.

Franklin Fair Prospect is one and one-half miles southeast of Mineral King, at the intersection of Fairwell Gap and Franklin cañons. Idle.

Bibl: State Mineralogist's Report XV, p. 950.

Monarch Mine, J. J. Davis, owner.

Silver King Claim is two miles southeast of Mineral King, in Franklin Cañon below Franklin Lake, at an elevation of 10,000 feet. M. C. Griggs of Three Rivers, former owner. Idle.

Bibl: State Mineralogist's Report XV, pp. 592–593.

White Horse and *Young America* prospects have now been taken in to the Sequoia National Park and are no longer developed.

Bibl: State Mineralogist's Report XV, p. 594.

Other lead-silver-zinc properties in the vicinity of Camp Wishon are:

King Solomon Claims, formerly known as Blackjack. D. Elkins, 140 N. Gardner street, Hollywood; and Bill Elster, Springville, owners. These two claims are located three miles southeast of Camp Wishon, near Alder Creek at an elevation of about 5000 feet. Timber abundant. The ore is reported to be chiefly zincblende (ZnS). An assay, reported to be made by Smith–Emery Co. of Los Angeles, shows: 29.61% zinc; 1.22% lead, 2.6 oz. silver, and a trace of gold. A tunnel is in about 220 feet. Assessments.

McGeorge, Geo.; five claims about two miles east of Camp Wishon; developed by open cuts and small tunnels.

Harding, John; one claim northeast of King Solomon claims; developed by small shaft, tunnel, and open cuts.

Harry Ford, Vergil Prichard, and Leslie Mumbleau own several claims above Camp Wishon, among which are the *Arsenic Spring* and *Soda Spring lead-zinc claims.*

Elster, Bill; owns the *Elder Berry claims.*

Also see *Powell Mine,* described in this report under 'Copper.'

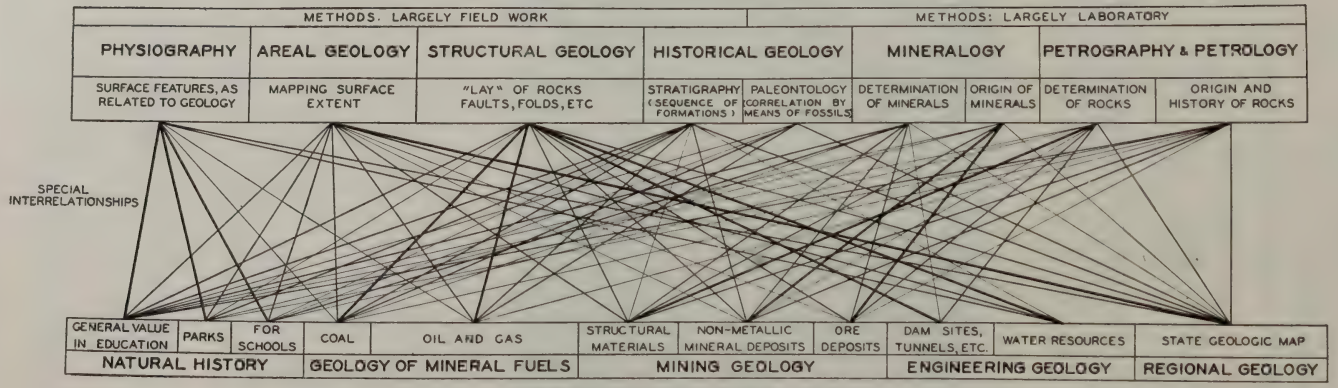
LOS ANGELES FIELD DIVISION

W. B. Tucker and R. J. Sampson, Mining Engineers

On account of unfinished field work, there is no report from the Los Angeles Field Division in this issue.

FUNCTION
OF THE
GEOLOGICAL AND ECONOMIC MINERAL SURVEY
CALIFORNIA STATE DIVISION OF MINES

FUNDAMENTAL GEOLOGICAL STUDY



ECONOMIC GEOLOGY

THE SCIENCE AS APPLIED TO INDUSTRY AND EDUCATION

GEOLOGIC BRANCH

Olaf P. Jenkins, Chief Geologist

Function and Scope.

The accompanying chart, entitled 'Function of the Geological and Economic Mineral Survey,' was prepared by the writer to show graphically how *economic* geology is related to the fundamental study of the *science* of geology.

Take, for example, the subject of *ore deposits*, which is part of mining geology. Five lines radiate from this subject: The heaviest is directed towards the origin of minerals, a branch of the science of mineralogy, which may be considered the most important part of the study of ore deposits, therefore the determination of minerals is also aptly connected by another line with the applied subject. Furthermore, a heavy line goes straight to structual geology, vital also for solving where ore bodies may lie buried. Areal geology, consisting of mapping the formations on the surface, is invariably done in order to present clearly the data gathered from rock exposures, and for this reason it is connected by a line with the subject of ore deposits. Likewise the origin and history of rocks which are solved through the study of petrography and petrology are very closely related to mining geology.

In another example: The geology of *oil and gas* is closely allied to stratigraphy and paleontology, as well as to structural and areal geology.

The writer has placed natural history and regional geology with the applied sciences, for they must necessarily be built up from the more rigid scientific studies. Both of these subjects, especially that of regional geology which may well be represented on a state geologic map, are of interest to almost everyone.

The geologic branch of the Division of Mines is engaged in the preparation of a large regional geologic map of the State of California. All fundamental subjects in geology go to build it up; but areal maps, showing the surface extent of rock formations, are most valuable to its construction. Data from many sources are being systematically compiled to form this important clearing house of geologic information. These features are brought out in the chart by the lines which radiate from the section called 'state geological map.'

Looking at the chart as a whole, we see that all the fundamental branches of the broad subject of geology go to to make up the applied science. Both field and laboratory work are involved.

The function of a state geological survey should be, therefore, to encourage all lines of scientific endeavor, from a point of view as broad and well-balanced as possible, in order to lay good foundations for the industrial and educational development of the state.

Mayo's Report on Mono County.

The following 'Preliminary Report on the Geology of Southwestern Mono County, California,' by Evans B. Mayo, represents a part of

one of the projects which the geologic branch has under way, in view of the final construction of a geologic map of the whole state.

Mr. Mayo's report in this issue of MINING IN CALIFORNIA represents a preliminary statement only. His final report is to be of much more detailed character. The results of his work represent a systematic study and a valuable contribution to the geology of a region heretofore not at all well understood and never before mapped in the manner he has done in the field.

PRELIMINARY REPORT OF THE GEOLOGY OF SOUTHWESTERN MONO COUNTY, CALIFORNIA

By Evans B. Mayo, Field Geologist

INTRODUCTION

Location.

The area described in the following report comprises a small part of the eastern face of the Sierra Nevada, together with some of the adjacent county to the east, all located in southwestern Mono County, California. The accompanying geologic map, which shows also an index sketch, may be consulted for its more graphic location of the area as well as for its representation of the areal extent of the geologic formations encountered.

Topographic maps of the United States Geological Survey were used as a base for mapping the geology of the region. The Mount Lyell and Mount Morrison quadrangles cover the greater portion of the area; also a strip along the northern border of the Mount Goddard quadrangle was included.

Extent of the Mapping.

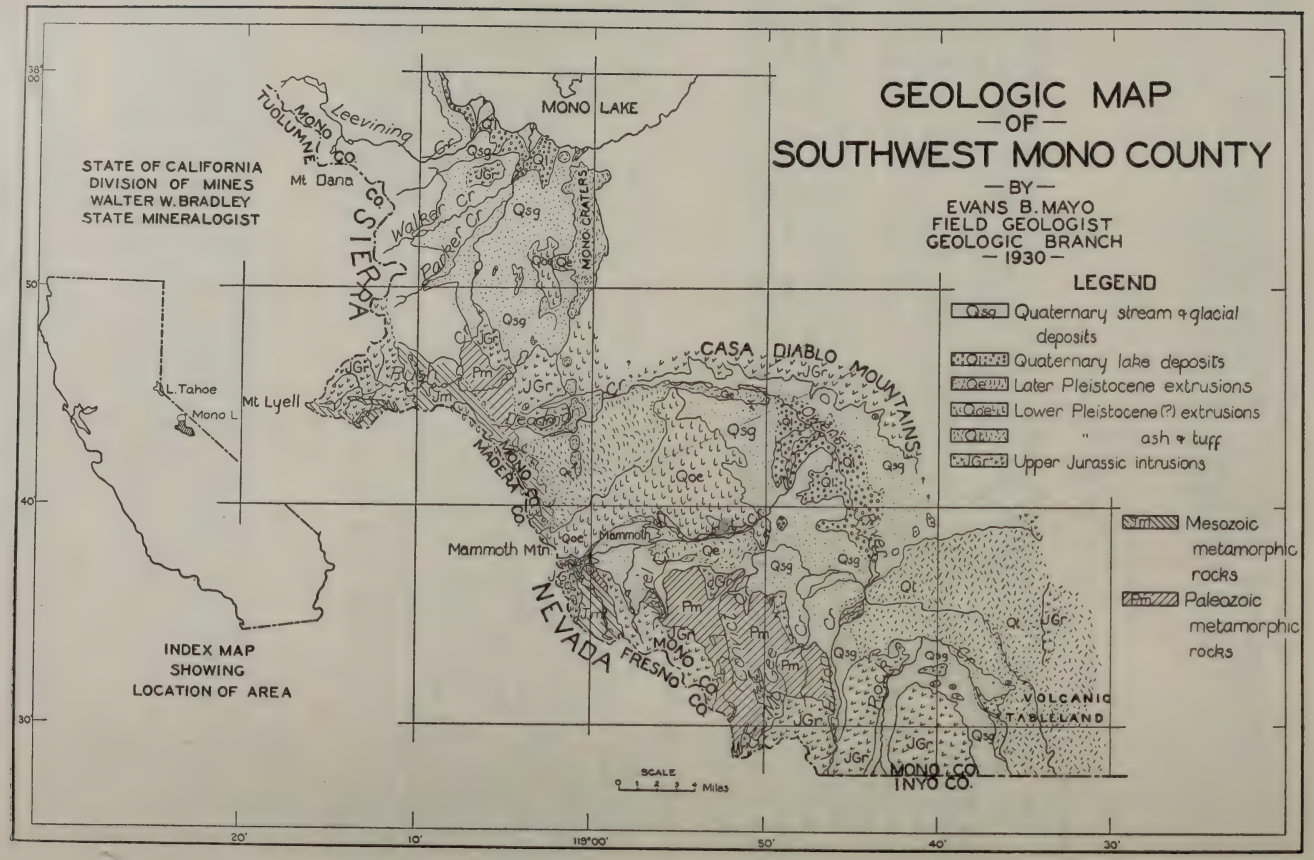
The writer spent, altogether, three summers in field work. The first work was in 1928, done on his own initiative; 100 square miles were mapped. The second and third summers of field work, in 1929 and 1930 respectively, were carried on under the auspices of the California State Division of Mines, and supervised by Olaf P. Jenkins, Chief Geologist. The area previously mapped was extended in 1929 southeastward to the northern boundary of Inyo County, and some work was done along the Middle Fork of the San Joaquin River, in northeastern Madera County. In 1930 the area mapped was still further extended northwestward in Mono County, to include the basin of Rush Creek. In all, about 1000 square miles have been mapped by the writer.

Acknowledgments.

On several occasions, each summer, the writer had conferences with Dr. Eliot Blackwelder, Professor of Geology at Stanford University. Doctor Blackwelder has spent several years in the study of the glacial deposits on the eastern slope of the Sierra Nevada, and the suggestions he has offered have been especially helpful in interpreting the Pleistocene geology.

In the summer of 1930, four days were spent in the field with Mr. H. D. Erwin, a graduate student of the University of California, who was then mapping the adjoining area in northeastern Madera County, also under the auspices of the Geologic Branch, State Division of Mines.

Thanks are due to Professor A. C. Gill of Cornell University for helpful suggestions given during the preparation of this paper.


GEOLOGIC MAP
—OF—
SOUTHWEST MONO COUNTY
—BY—
EVANS B. MAYO
FIELD GEOLOGIST
GEOLOGIC BRANCH
—1930—
STATE OF CALIFORNIA
DIVISION OF MINES
WALTER W. BRADLEY
STATE MINERALOGIST
LEGEND
Qsg Quaternary stream & glacial deposits
Ql Quaternary lake deposits
Qe Later Pleistocene extrusions
Qoe Lower Pleistocene (?) extrusions
" ash & tuff
JGr Upper Jurassic intrusions
Mesozoic metamorphic rocks
Paleozoic metamorphic rocks
MONO LAKE
Leevining Cr
Walker Cr
Parker Cr
MONO CRATERS
CASA DIABLO MOUNTAINS
Mt Dana
Mt Lyell
L. Tahoe
Mono L
Mammoth Mtn
Mammoth
MONO CO
MADERA CO
FRESNO CO
INYO CO
NEVADA
VOLCANIC TABLELAND
SCALE
INDEX MAP
SHOWING
LOCATION OF AREA

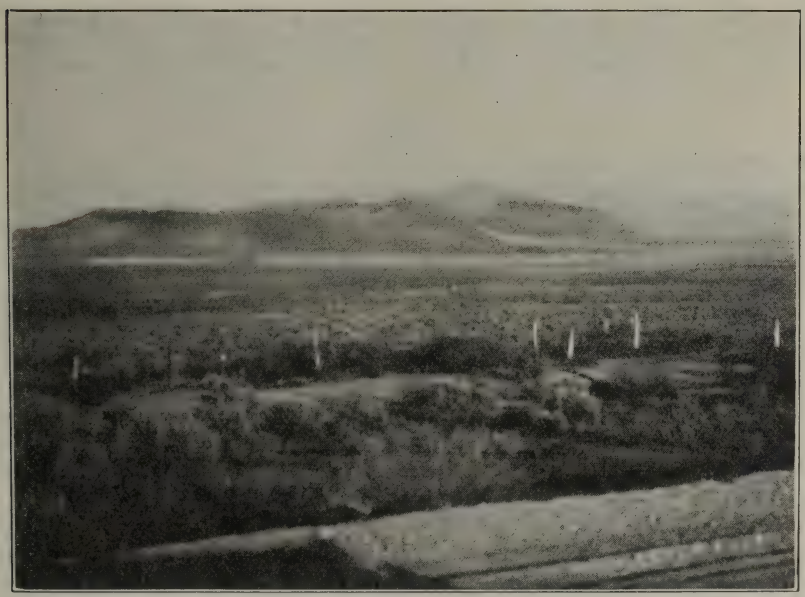
Problems for Future Study.

It is planned that a more complete report on the geology of the area studied will appear in the future. In the present paper, the writer has endeavored to outline the more general geologic features together with the progress of his work. He fully realizes that much more work must be done in this and in adjoining districts before many of the problems can be solved. Some of the questions on which more information is desired are as follows: (1) The correlation of the older formations of this area with those of other parts of the state. (2) The nature and origin of the complex structures in the older rocks. (3) The age of the older Cenozoic lava flows. (4) The age and nature of the movements along faults that have given the Sierra Nevada its present elevation.

PHYSIOGRAPHY

Topography and Relief.

The southwestern boundary of Mono County runs along the crest of the Sierra Nevada, and the area included in this paper covers the



Mono Craters, from the northwest. Photo by Walter W. Bradley.

short, steep eastern slope of this mountain range and adjoining portions of the hills, valleys, and intermontane basins immediately east of it. The maximum relief, from the surface of Mono Lake to the highest point on the crest, is about 6700 feet. The topographic expression varies in general from the extremely rugged peaks and gorges of the high mountains, some of whose summits are more than 13,000 feet above sea level, to more subdued forms of hill and valley farther east. Two notable exceptions east of the Sierra are the range of rugged volcanoes south of Mono Lake, known as the Mono Craters, and the

lofty south-facing escarpment of the Casa Diablo Mountains, north of Long Valley.

Precipitation, Drainage and Vegetation.

Most of the water discharged from the area has its origin in the melting snow along the crest of the Sierra, where the annual precipitation, the greater part of which falls during the winter, averages about forty inches. In the lower valleys east of the Sierra, this average may be even less than twenty inches.[1] The streams in this part of Mono County empty into two drainage basins. Those in the southern part of the area are tributaries of Owens River, while Rush Creek and its feeders in the northern portion drain into Mono Lake.

The lower valleys and hillsides are covered with a rather thick growth of sagebrush, except where water from mountain streams penetrates the dry, dusty soil and furnishes moisture for grassy meadows. Hilltops and the slopes of lower mountains are dotted with a thin, scattered growth of piñons, and favored areas in the high mountains are covered with evergreen forest up to an elevation of about 11,000 feet. Above this, small water-saturated meadows with a flora consisting of grass and moss occur on cirque floors. Occasionally tiny flowering plants may be found growing in cracks in the bare rock of the high peaks.

GEOLOGY

Geologic Units.

In southwest Mono County, the eastern flank of the Sierra Nevada is made up essentially of the following: (1) Metamorphic rocks ranging in age from Cambrian to Jurassic, according to the best evidence it has been possible to collect in the field and from the literature;[2] (2) the rocks of the Sierra Nevada batholith which has intruded them; and (3) lava flows that have been poured out over the eroded surface of both the batholith and the metamorphic rocks.

The Paleozoic rocks, which are characteristically exposed southeast of Mammoth, include slate, hornfels, marble (crystalline limestone), and a type of metaquartzite that has apparently been derived from limestone by silicification. With the possible exception of a few small members of doubtful origin, the Paleozoic rocks were marine sediments.

Overlying the Paleozoic rocks stratigraphically, but generally occurring more to the west, is a great series of schistose, slaty, and gneissose rocks that were at one time lava flows, beds of ash and volcanic breccia with occasional lenses of chemical sediments (now silicified marble), and a few small granitic and dioritic intrusions that preceded the Sierra Nevada batholith. Typical exposures of this series occur about five miles southwest of Mammoth and in the upper portion of the basin of Rush Creek. These formations seem to be at least in part of Triassic and Jurassic age, as is indicated by their relations to rocks

[1] Lee, Charles H., An intensive study of the water resources of a part of Owens Valley, California: U. S. Geol. Survey, Water Supply Paper 294, p. 28, 1912. Gives a map showing the precipitation over part of eastern California.

[2] Walcott, Charles D., Lower Cambrian rocks in eastern California: Am. Jour. Sci., 3d ser., vol. 49, pp. 141–144, 1895.

Knopf, Adolph, and Kirk, Edwin, A geologic reconnaissance of the Inyo Range and the eastern slope of the Sierra Nevada, California: U. S. Geol. Survey, Prof. Paper 110, 1918.

studied by Turner and Knopf,[1] though some rocks closely associated with these may have been formed in upper Paleozoic time.

These rocks were intruded by a huge batholith of granodiorite and related granitic segregation products, probably in upper Jurassic time, as determined by J. P. Smith.[2]

At present the metamorphic rocks of southwestern Mono County rest on a base of granite or granodiorite, as huge roof pendants, so that on the geologic map, great tongue-like strips of igneous rock appear separating tongues or wedge-shaped strips of metamorphic rocks. Occasional small ridges and knobs of granite protrude above a covering of younger pyroclastic material on Volcanic Tableland, and the entire southern face of the Casa Diablo Mountains is made of granite. This strongly indicates that the extreme eastern border of the batholith lies many miles beyond the present base of the Sierra Nevada.

Overlying the metamorphic rocks and igneous intrusions, and separated from them by a profound erosional unconformity, are lava flows, and extensive beds of pyroclastic materials that have been ejected from time to time during the comparatively recent geologic past. In general, the eruptive sequence of these extrusions appears to have been as follows:

1. Basalt.
2. Andesite.
3. Rhyolite.
4. Basalt.
5. Rhyolite.

The age of (1), (2), and (3) is somewhat doubtful as yet, but the field evidence gathered thus far favors their assignment to an early Pleistocene age, instead of Pliocene as might be assumed from analogy with similar deposits described from the west side of the mountains.[3] Stages (4) and (5) are doubtless of upper Pleistocene age, since they occur as cones showing little effect of erosion, as well as flows almost equally free from dissection. In fact, some eruptions belonging to stage (5) occurred during or after the last glacial epoch, since moraines of this epoch are thinly covered with pumice thrown out by volcanoes of stage (5). Thick deposits of unconsolidated rhyolitic pumice, locally underlain or even interbedded with basaltic lapilli, cover many square miles north and west of Mammoth. The rhyolitic material is assigned to stage (5), while the lapilli, in general older, though occasionally interbedded with the pumice, seem to belong to stage (4).

Fragmental deposits of Pleistocene age and sedimentary origin are conspicuous and important in the lower parts of the area. Moraines and till, which will probably be fully described by Dr. Eliot Blackwelder, were observed near the base of the Sierra in such relationships as to indicate at least four periods of glaciation. Till of the first epoch, covering an area too small to be shown on the map, caps McGee Mountain, a lesser summit on the Sierran front, where it has been left perched as a result of erosion. Moraines of the second, third, and fourth epochs occur in and below the mouths of the Sierran canyons.

[1] Knopf, Adolph, op. cit., p. 59.
Turner, H. W., Further contributions to the geology of the Sierra Nevada: U. S. Geol. Survey, Seventeenth Ann. Rept., pt 1, 1895–96, pp. 711–713, 1896.

[2] Smith, J. P., Salient events in the geologic history of California; Science, new ser., vol. 30, pp. 346–350, 1909.

[3] Chaney, Ralph W., The Mescall flora—its distribution and climatic relation; Carnegie Inst., Washington, Pub. 349, II, pp. 32–33, 1925.

Extensive cones and irregular areas of talus in the high mountains grade into the fanglomerate of the piedmont slope, and this, in turn, into the sands and silts of the valley bottoms. In Long Valley, thick deposits of diatomite and lacustrine clay, laid down in the quiet water of a Pleistocene lake, are overlain by tuffaceous conglomerate and sandstone deposited during the closing stage of the lake. Lacustrine sediments are also found in the Mono Basin above the present lake level.[1]

Geologic Structure.

The general strike of the bedding or schistosity in the metamorphic rocks, and the trend of folds in them is about N. 35° W., or approximately a direction parallel to the trend of the Sierra Nevada. In general, the degree of folding has passed the isoclinal stage at which opposite sides of the fold are parallel, so that crumpling of the sides and squeezing of the cores can be observed in some localities. Nearly all of the folds seen are overturned to some extent, but recumbent folds, those in which the axial plane is essentially horizontal, are rare, and have been found only in close association with thrust faulting. The best noted example of a recumbent fold is on the high divide east of the head of Convict Creek. Most of the folds observed are overturned toward the east.

The older faults in the area are of the type caused by compression, and were doubtless formed at the same time as the folds. Those observed (there were probably many others) vary from reversed strike faults of small displacement to overthrusts of which the observable displacement exceeds half a mile. One such case occurs associated with the recumbent fold referred to above. Normal faults, possibly due to readjustments following the period of compression, are common. A few of these faults were seen to have a displacement of several thousand feet, but most of those observed are much smaller than this.

The structures noted above occur in the metamorphic rocks, and have been produced by the forces that accompanied the intrusion of the Sierra Nevada batholith. Both normal and reverse faulting of much later date displaces some of the earlier Pleistocene (?) lavas, and of these the normal faults were seen to displace the metamorphic series that underlies them. Where the younger rocks do not occur, faulting belonging to this period has not been distinguished from that which is the result of earlier movements. It is of interest to note here that a large part of the displacement producing the escarpments of the Sierra Nevada and of the Casa Diablo Mountains may have occurred since the beginning of the Pleistocene time.

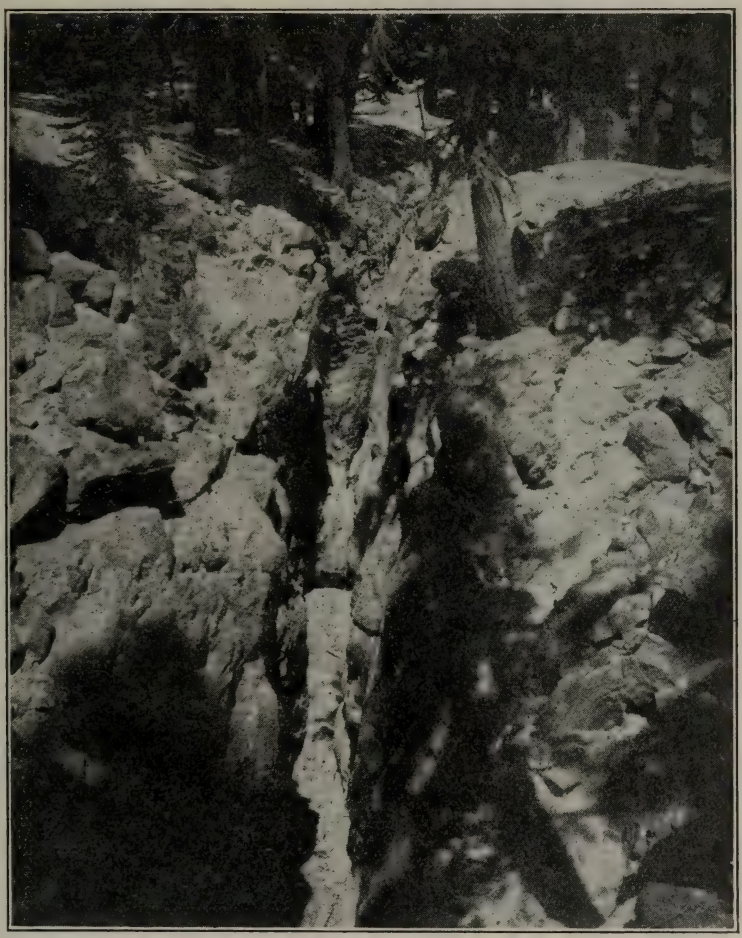
The latest structural features to be observed in the region are open fissures, of which perhaps twenty were observed in different parts of the area. The 'Earthquake Fault,' about six miles north of Mammoth, is an imposing example. At some places in the area, notably along Hot Creek and in the lava hills near it, the trend of these fissures is marked by lines of hot springs and steam vents.

[1] Russell, I. C., Quaternary history of Mono Valley, California: U. S. Geol. Survey Eighth Ann. Rept., pt. 1, 1886–87, pp. 287–320, 1889.

ECONOMIC GEOLOGY

Water Supply.

In Mono County, as elsewhere in California, the very important problem of water supply appears. The entire area under consideration is included in the proposed extension of the Los Angeles water supply system. A dam, to be built at the outlet of Long Valley, will create a large storage reservoir. A tunnel through the divide between



'Earthquake Crack,' six miles north of Mammoth, Mono County, California.
Photo by Walter W. Bradley.

Deadman Creek and Mono Basin, and dams constructed across water courses in this basin, will divert water from Rush, Parker, Walker, and Leevining creeks through the divide and into the reservoir in Long Valley, which, of course, will also be fed by the creeks naturally draining into this valley. Obviously, all available geologic data should be used in planning and constructing these extensions.

Water Power.

Some of the power generated by the swift mountain streams is now being converted into electric energy by the Southern Sierra Power Company, which has hydroelectric stations on Rush and Leevining creeks.

Road Material.

This part of Mono County is well favored in the matter of road materials. Many miles of road are built over fanglomerate, which, when packed, smoothed, and oiled, makes a good roadbed. In the extreme southern part of the county the state highway is built over consolidated ash and pumice, which has been finely broken up on the surface, compacted, and oiled. This has been done with excellent results. In the northern part of the area, several miles of roadbed have been built over soft pumice, ash, and glacial till by covering these with a layer of basaltic lapilli. This material, when compacted and oiled, makes a very serviceable road.

Ore Deposits.

Small contact metamorphic deposits of tungsten and molybdenum ores occur at various places along the contact of the batholith with metamorphic rocks. The deposits observed seem to be replacements of crystalline limestone members in the intruded rock.

High-temperature veins, carrying zinc, lead, copper, and silver, occur in marble as far as half a mile from the intrusive contact, as it appears at the surface. The vertical distance from such mineralization to the igneous rock may be much less than this.

At Mammoth, high-temperature gold-quartz veins have been found in silicified rocks, apparently of volcanic origin. With the exception of the Mammoth mine, none of the ore bodies in the area have thus far been notably productive, though of course it is impossible to predict the results of future developments.

OIL FIELD DEVELOPMENT OPERATIONS

R. D. Bush, State Oil and Gas Supervisor

From June 29, 1930, to and including September 27, 1930, the following new wells were reported as ready to drill:

Company	Sec.	Twp.	Range	Well No.	Field
FRESNO COUNTY:					
The Ohio Oil Co.	4	21	15	Welsh & Brix 1	Coalinga
Associated Oil Co.	22	21	15	Mitchell 1	
KERN COUNTY:					
General Petroleum Corp.	30	28	21	Berry 1	Belridge
The Ohio Oil Co.	36	27	20	Bloomer 1	Belridge
The Ohio Oil Co.	30	28	21	37	Belridge
C. C. M. O. Co.	23	28	27	36	Kern River
C. C. M. O. Co.	23	28	27	37	Kern River
George F. Getty, Inc.	12	26	20	Lincoln drilling 1	Lost Hills
George F. Getty, Inc.	12	26	20	Lincoln drilling 1-A	Lost Hills
C. C. M. O. Co.	8	32	23	87	Midway
Federal Drilling Co.	20	31	24	6	Midway
Standard Oil Co.	1	32	23	46	Midway
Standard Oil Co.	3	32	24	67	Midway
Union Oil Co.	22	32	23	Editor 1	Midway
General Petroleum Corp.	16	27	28	Heisen 32	Mt. Poso
C. C. M. O. Co.	6	28	29	1	Round Mountain
Honolulu Consolidated Oil Co.	20	28	29	3-A	Round Mountain
Range Oil Co., Ltd.	36	28	28	1	Round Mountain
Shell Oil Co.	19	28	29	Jewett 3-4	Round Mountain
Shell Oil Co.	21	28	29	Louis Olcese 1	Round Mountain
Shell Oil Co.	29	28	29	Jewett 13	Round Mountain
Doyle Petroleum Corp.	8	11	23	Son-Crail 9	Sunset
Maricopa Star Oil Co.	32	12	23	9	Sunset
North American Oil Consolidated	8	11	23	Sunset 6	Sunset
Standard Oil Co.	5	11	23	60	Sunset
Standard Oil Co.	5	11	23	68	Sunset
Union Oil Co.	8	11	23	Son 2	Sunset
Wellington Oil Co., Ltd.	8	11	23	Wellington-Maricopa 4	Sunset
Meridian Oil Co., Ltd.	11	9	15	1	
Petroleum Securities Co.	14	29	29	Johnson-Moss 1	
KINGS COUNTY:					
Continental Oil Co.	2	22	17	2-16	Kettleman Hills
Milham Exploration Co.	1	22	17	23	Kettleman Hills
Pacific Western Oil Co.	1	22	17	12	Kettleman Hills
Standard Oil Co.	3	22	17	32	Kettleman Hills
LOS ANGELES COUNTY:					
Standard Oil Co.	17	2	14	Los Angeles Investment 1-64	Inglewood
Standard Oil Co.	17	2	14	Vickers 1, 25	Inglewood
Baxter Petroleum Co., Ltd.	13	4	13	1	Long Beach
Philip L. Bixby	19	4	12	4	Long Beach
Robert Bowles Oil Co.	29	4	12	5	Long Beach
Cash Oil Co. Well No. 1, Ltd.	18	4	12	1	Long Beach
Combs-Weaver	18	4	12	1	Long Beach
Combs-Weaver	29	4	12	3	Long Beach
Dabney-Johnston Oil Corp.	18	4	12	78	Long Beach
Dabney-Johnston Oil Corp.	29	4	12	76	Long Beach
Dabney-Johnston Oil Corp.	29	4	12	77	Long Beach
Dabney-Johnston Oil Corp.	29	4	12	79	Long Beach
Dabney-Johnston Oil Corp.	13	4	13	80	Long Beach
Davis Investment Co.	29	4	12	17	Long Beach
El Capitan Oil Co.	29	4	12	1	Long Beach
Golden Gate Oil Co., Ltd.	18	4	12	1	Long Beach
The Hancock Oil Co.	18	4	12	Signal 4	Long Beach
Otis Hoyt	29	4	12	13	Long Beach

OIL FIELD DEVELOPMENT OPERATIONS—Continued

Company	Sec.	Twp.	Range	Well No.	Field
LOS ANGELES COUNTY—Cont.					
Jeroil Corp., Ltd.	29	4	12	1	Long Beach
A. N. Macrate	29	4	12	Severns 1	Long Beach
Magna Oil and Gas Co., Ltd.	29	4	12	The Emblem 1	Long Beach
McFadden & Luke	18	4	12	1	Long Beach
McKeon Oil Co.	29	4	12	8	Long Beach
McKeon Oil Co.	29	4	12	9	Long Beach
Petroleum Securities Co.	29	4	12	Kale 1	Long Beach
Petroleum Securities Co.	29	4	12	Painted Hills 3	Long Beach
Republic Petroleum Co.	29	4	12	1	Long Beach
Richfield Oil Co.	19	4	12	Simplex 4	Long Beach
Richfield Oil Co.	24	4	13	Duncan 6	Long Beach
Robal Petroleum, Ltd.	18	4	12	1	Long Beach
Shell Oil Co.	29	4	12	Jones Comm. 12	Long Beach
Shell Oil Co.	29	4	12	Patton-Wilson 12	Long Beach
Shell Oil Co.	29	4	12	Stakemiller 8	Long Beach
Signal Oil and Gas Co.	29	4	12	Signal-Goodyear 2	Long Beach
Signal Oil and Gas Co.	29	4	12	Signal-Goodyear 2	Long Beach
George N. Snyder	18	4	12	3	Long Beach
George N. Snyder	29	4	12	2	Long Beach
Stevenson Bros.	28	4	12	1	Long Beach
The Texas Co.	29	4	12	Perrin 3	Long Beach
Two and One Oil Co.	18	4	12	Two and One 1	Long Beach
Washington Oil Co., Ltd.	13	4	13	2	Long Beach
West American Oil Co.	19	4	12	D.V.L.P. 1	Long Beach
Wood-Callahan Oil Co.	29	4	12	S. S. Wortley 2	Long Beach
Young Petroleum Corp.	29	4	12	2	Long Beach
Southern California Drilling Co.	13	3	16	Needham 4	Newhall
Southern Production Co., Ltd.	6	3	15	1	Newhall
York-Smullin Oil Co.	13	3	16	3	Newhall
Acme Royalties, Ltd.	21	2	15	1	Playa del Rey
F. D. Allen	28	2	15	1	Playa del Rey
Allied Petroleum Corp.	21	2	15	Rawco-Gans 1	Playa del Rey
Allstate Petroleum Corp., Ltd.	21	2	15	1	Playa del Rey
Altadena Oil Co.	21	2	15	Altadena 1	Playa del Rey
Balboa Oil Co.	21	2	15	1	Playa del Rey
Barnsdall Oil Co.	28	2	15	Burks 13	Playa del Rey
Barnsdall Oil Co.	28	2	15	13-A	Playa del Rey
Beverly Hills Petroleum Corp.	28	2	15	Burkholder 1	Playa del Rey
Bishop Corp.	21	2	15	Venice 1	Playa del Rey
C. W. Bland	28	2	15	Bland 1	Playa del Rey
Brunwin-Clark & Bean	21	2	15	1	Playa del Rey
Burket & Braun	21	2	15	2	Playa del Rey
Burket & Braun	21	2	15	3	Playa del Rey
Burket & Braun	21	2	15	Burket & Braun 1	Playa del Rey
Byrens et al	21	2	15	Burns 1	Playa del Rey
California Northern Corp.	21	2	15	1	Playa del Rey
California Northern Corp.	21	2	15	2	Playa del Rey
California Northern Corp.	21	2	15	4	Playa del Rey
California Northern Corp.	28	2	15	5	Playa del Rey
Carbon Oil Co., Ltd.	21	2	15	1	Playa del Rey
Chanel Oil Co., Ltd.	21	2	15	Joann 1	Playa del Rey
Clark Oil & Royalties Corp., Ltd.	21	2	15	1	Playa del Rey
Community Monarch Petroleum Co.	21	2	15	1	Playa del Rey
Corrigan Petroleum Corp., Ltd.	21	2	15	Babe Allison 1	Playa del Rey
Corrigan Petroleum Corp., Ltd.	21	2	15	Babe Allison 2	Playa del Rey
W. A. Cory & Robert A. Randall	21	2	15	1	Playa del Rey
Crawford & Gilkey	21	2	15	1	Playa del Rey
Henry R. Dabney Oil Co., Ltd.	21	2	15	Venice 1	Playa del Rey
Dana Petroleum	21	2	15	1	Playa del Rey
John B. deMaria, Jr.	21	2	15	1	Playa del Rey
Deuel Petroleum Corp., Ltd.	21	2	15	Deuel 2	Playa del Rey
Joseph M. Devere	21	2	15	Grafton 1	Playa del Rey
El Jemaro Oil Co.	21	2	15	1	Playa del Rey
The Elmer Co., Ltd.	21	2	15	6	Playa del Rey
The Elmer Co., Ltd.	28	2	15	4	Playa del Rey

OIL FIELD DEVELOPMENT OPERATIONS—Continued

Company	Sec.	Twp.	Range	Well No.	Field
LOS ANGELES COUNTY—Cont.					
The Elmer Co., Ltd.	28	2	15	5	Playa del Rey
Farrell Petroleum	21	2	15	1	Playa del Rey
Gantz Oil Syndicate	28	2	15	1	Playa del Rey
George F. Getty, Inc.	28	2	15	V-2	Playa del Rey
George F. Getty, Inc.	28	2	15	V-3	Playa del Rey
George F. Getty, Inc.	28	2	15	V-4	Playa del Rey
George F. Getty, Inc.	28	2	15	V-5	Playa del Rey
Goetz Petroleum Corp., Ltd.	21	2	15	1	Playa del Rey
Goldsmith Bros., Inc., Ltd.	21	2	15	1	Playa del Rey
Goodfield Petroleum, Ltd.	28	2	15	1	Playa del Rey
H. L. J. Oil Co., Ltd.	21	2	15	1	Playa del Rey
Hampton & Co., Inc.	21	2	15	1	Playa del Rey
Grace Bryan Hargraves	21	2	15	1	Playa del Rey
Imperial Gypsum & Oil Corp.	21	2	15	Playa del Rey 1	Playa del Rey
International Petroleum Corp.	28	2	15	1	Playa del Rey
A. T. Jergins Trust	21	2	15	Capp 1	Playa del Rey
A. T. Jergins Trust	21	2	15	Meyers 1	Playa del Rey
A. T. Jergins Trust	28	2	15	Culver 1	Playa del Rey
A. T. Jergins Trust	28	2	15	Moore 1	Playa del Rey
Thomas Kelly & Sons, Inc.	28	2	15	1	Playa del Rey
Thomas Kelly & Sons, Inc.	28	2	15	2	Playa del Rey
Thomas Kelly & Sons, Inc.	28	2	15	Kelly-Prentiss 6	Playa del Rey
J. D. Keen, A. E. Austin, Lynn H. Case & Grant Leslie	21	2	15	Coloma 1	Playa del Rey
Knickerbocker Oil Co., Ltd.	21	2	15	2	Playa del Rey
Knox Powell Stockton Co., Inc., Ltd.	21	2	15	1	Playa del Rey
Knox Powell Stockton Co., Inc., Ltd.	21	2	15	W. G. Davis 2	Playa del Rey
La Bara Oil Co.	21	2	15	Strain 1	Playa del Rey
La Bara Oil Co.	21	2	15	Strain 3	Playa del Rey
Lang-Wall	21	2	15	Lang-Wall 1	Playa del Rey
Lubrite Oil Co. of California, Ltd.	28	2	15	1	Playa del Rey
M. C. R. R. Co., Ltd.	21	2	15	1	Playa del Rey
Marcell Oil & Gas Corp.	21	2	15	1	Playa del Rey
Marcell Oil & Gas Corp.	28	2	15	2	Playa del Rey
W. P. Mason	21	2	15	1	Playa del Rey
W. P. Mason	21	2	15	2	Playa del Rey
McDonald Petroleum, Ltd.	28	2	15	4	Playa del Rey
Metropolitan Oil Corp.	28	2	15	Stanley 1	Playa del Rey
Bert E. Minch	21	2	15	2	Playa del Rey
Bert E. Minch	21	2	15	3	Playa del Rey
Bert E. Minch	21	2	15	Bert E. Minch 1	Playa del Rey
Mohawk Petroleum Co.	21	2	15	Tuttle 1	Playa del Rey
Mohawk Petroleum Co.	28	2	15	I. 1	Playa del Rey
Mohawk Petroleum Co.	28	2	15	K. 1	Playa del Rey
Mohawk Petroleum Co.	28	2	15	L. 1	Playa del Rey
Mohawk Petroleum Co.	28	2	15	O. 1	Playa del Rey
Mohawk Petroleum Co.	28	2	15	O. 2	Playa del Rey
B. C. Morrison	28	2	15	4	Playa del Rey
B. C. Morrison, Venice No. 2	28	2	15	2	Playa del Rey
Clyde H. Nelson	21	2	15	1	Playa del Rey
Clyde H. Nelson	28	2	15	2	Playa del Rey
Northern Investment Co.	21	2	15	Booth 1	Playa del Rey
Northern Investment Co.	21	2	15	Booth 5	Playa del Rey
The Ohio Oil Co.	28	2	15	Block H 1	Playa del Rey
The Ohio Oil Co.	28	2	15	Block I 1	Playa del Rey
The Ohio Oil Co.	28	2	15	Block K 1	Playa del Rey
The Ohio Oil Co.	28	2	15	Recreation Gun Club 3	Playa del Rey
The Ohio Oil Co.	28	2	15	Recreation Gun Club 4	Playa del Rey
The Ohio Oil Co.	28	2	15	Recreation Gun Club 5	Playa del Rey
Osage Oil Co.	28	2	15	1	Playa del Rey
Pacific Coast Properties, Ltd.	28	2	15	Hunter 1	Playa del Rey
Pacific Shore Oil Co., Ltd.	21	2	15	1	Playa del Rey
Pacific Western Oil Co.	21	2	15	Stanley-Lieber 1	Playa del Rey
Pan Gulf Petroleum Co., Ltd.	21	2	15	1	Playa del Rey
Pan Gulf Petroleum Co., Ltd.	28	2	15	1	Playa del Rey
Rohde Oil Syndicate No. 5	28	2	15	Rohde 5	Playa del Rey

OIL FIELD DEVELOPMENT OPERATIONS—Continued

Company	Sec.	Twp.	Range	Well No.	Field
LOS ANGELES COUNTY—Cont.					
San Vicente Oil Co.	21	2	15	1	Playa del Rey
Joseph Schenk Production, Inc. & John Consindine, Jr.	28	2	15	1	Playa del Rey
Seashore Petroleum Corp., Ltd. & Deuel Petroleum Corp., Ltd.	21	2	15	1	Playa del Rey
Silver Strand Oil Co.	21	2	15	1	Playa del Rey
St. Catherine Oil Corp., Ltd.	28	2	15	Patricia 1	Playa del Rey
Star Petroleum Co.	21	2	15	V. 3	Playa del Rey
Tideland Oil Co., Ltd.	28	2	15	1	Playa del Rey
J. W. Todd Oil Co., Ltd.	21	2	15	1	Playa del Rey
Toy Petroleum Co., Ltd.	28	2	15	1	Playa del Rey
Treasure Oil Co.	21	2	15	1	Playa del Rey
Union Oil Co.	28	2	15	Townsite 1	Playa del Rey
Union Oil Co.	28	2	15	Townsite 2	Playa del Rey
Union Oil Co.	28	2	15	Townsite 3	Playa del Rey
Union Oil Co.	28	2	15	Townsite 4	Playa del Rey
Unity Oil Co., Ltd.	28	2	15	1	Playa del Rey
Venice Oil Syndicate No. 2	21	2	15	2	Playa del Rey
Venice Oil Syndicate No. 3	21	2	15	3	Playa del Rey
Venice Oil Syndicate No. 4	21	2	15	4	Playa del Rey
Venice Pacific Oil Co., Ltd.	28	2	15	1	Playa del Rey
West Port Petroleum Corp., Ltd.	27	2	15	1	Playa del Rey
George Wolfe	21	2	15	Wolfe 1	Playa del Rey
George Wolfe	28	2	15	3	Playa del Rey
York-Smullin Oil Co.	21	2	15	Jones-Prentiss 2	Playa del Rey
Inter-Coast Oil and Transport Co., Ltd.	28	2	14	Inter-Coast Oil Co. G.P. 2	Potrero
Star Petroleum Co.	28	2	14	Potrero 1	Potrero
Stillion & Hillegas	28	2	14	1	Potrero
Wilcox & Schirm	28	2	14	1	Potrero
Barnsdall Oil Co.	18	3	13	Trust 2	Rosecrans
George F. Getty, Inc.	5	3	11	S. F. S. 50	Santa Fe Springs
Continental Oil Co.	3	5	12	McGrath & Selover 24	Seal Beach
Arden Oil Co., Ltd.	15	2	10	Rowland 1	
G. H. Carlyle	9	3	13	1	
E. U. Combs	16	3	13	1	
Fred H. Hammer	24	1	13	1	
Olympic Realty Corp.	14	2	15	1	
Widney, Widney & Miller, et al	36	5	15	1	
ORANGE COUNTY:					
Rex Oil Co.	2	6	11	16	Huntington Beach
Richfield Oil Co.	2	6	11	Dieter-Golay 3	Huntington Beach
Standard Oil Co.	34	5	11	Huntington A 33	Huntington Beach
Standard Oil Co.	34	5	11	Jones Comm. 6	Huntington Beach
Standard Oil Co.	12	6	11	Thomson 13	Huntington Beach
SAN BERNARDINO COUNTY:					
P. M. Peterson	17	4	1	Moore 1	
SAN LUIS OBISPO COUNTY:					
Carl J. Shilling, Ltd.	1	29	12	1	
SANTA BARBARA COUNTY:					
Bankline Oil Co.	15	4	29	89-7	Elwood
Barnsdall Oil Co.	15	4	29	88-4	Elwood
Barnsdall Oil Co.	15	4	29	Doty 7	Elwood
Barnsdall Oil Co.	16	4	29	88-5	Elwood
Elwood Exploration Co.	15	4	29	90-7	Elwood
Elwood Exploration Co.	22	4	29	90-5	Elwood
Pacific Western Oil Co.	16	4	29	92-6	Elwood
Pacific Western Oil Co.	16	4	29	92-7	Elwood
Vaqueros Major Oil Co., Ltd.	6	7	33	2	Lompoc
General Petroleum Corp.	21	4	28	Moore 3	
General Petroleum Corp.	32	5	30	Erburu 7	
General Petroleum Corp.	32	5	30	Erburu 8	
Western Gulf Oil Co.	5	9	33	Bradley B 1	
N. S. Wilson	2	7	33	1	

OIL FIELD DEVELOPMENT OPERATIONS—Continued

Company	Sec.	Twp.	Range	Well No.	Field
SHASTA COUNTY:					
The Red Head Oil Co.	15	30	5	1	
TULARE COUNTY:					
Ford Alexander, et al	34	22	27	1	
Allen F. Bullard	35	22	27	Gardner 1	
W. A. Campbell	22	22	27	1	
Consolidated Properties, Ltd.	35	22	27	2	
Consolidated Properties, Ltd.	35	22	27	Gardner 1	
Cumming Petroleum, Ltd.	27	22	27	Scantli 1	
Hagerty & Caine, Trustees	7	23	28	1	
William A. Hallock	34	22	27	1	
Jaques Oil Co.	34	22	27	1	
Jennings Syndicate	8	23	28	McMasters 1	
Kettleman East Side Trust	21	22	27	1	
L. H. Larson & M. A. Stanford	11	23	27	1	
Paul M. Lewis	15	22	27	1	
Lypps, Berghofer & LeMohn	29	23	28	1	
Miller & Sullivan	11	23	27	1	
Rayatt Oil Corp., Ltd.	34	22	27	Hinshaw 1	
Terra Bella Drilling Co., Ltd.	34	22	27	1	
Terra Bella Drilling Co., Ltd.	34	22	27	Keen 1	
Turk-Campbell Petroleum Co.	34	22	27	1	
United Kern Petroleum, Inc., Ltd.	34	22	27	1	
VENTURA COUNTY:					
C. C. M. O. Co.	8	3	24	Hobson B 12	Rincon
Pan American Petroleum Co.	8	3	24	Hobson-State 3	Rincon
Richfield Oil Co.	8	3	24	Miley-Hobson 4	Rincon
California Republic Petroleum Corp., Ltd.	23	4	21	1	Santa Paula
Pan American Petroleum Co.	34	3	18	Tapo 49	Simi
Pan American Petroleum Co.	36	3	18	Tapo 48	Simi
Richfield Oil Co.	36	3	18	Marr 16	Simi
Associated Oil Co.	26	3	23	Lloyd 85	Ventura
Associated Oil Co.	26	3	23	V. L. & W. 15	Ventura
Associated Oil Co.	26	3	23	V. L. & W. 17	Ventura
Shell Oil Co.	29	3	23	Taylor 64	Ventura
YOLO COUNTY:					
George F. Getty, Inc.	23	12	3	Guinda 1	

SPECIAL ARTICLES

Detailed technical reports on special subjects, the result of research work on extended field investigations, will continue to be issued as separate bulletins by the Bureau, as has been the custom in the past.

Shorter and less elaborate technical papers and articles by members of the staff and others are published in each number of 'Mining in California.'

These special articles cover a wide range of subjects both of historical and current interest; descriptions of new processes, or metallurgical and industrial plants, new mineral occurrences, and interesting geological formations, as well as articles intended to supply practical and timely information on the problems of the prospector and miner, such as the text of the new laws and official regulations and notices affecting the mineral industry.

BIENNIAL REPORT OF THE STATE MINERALOGIST

To His Excellency Hon. C. C. Young,
Governor of California.

Sir: Herein I have the honor to present the biennial report of the State Mineralogist as required by law (Stats. 1913, Chap. 679) covering the work and activities of the State Division of Mines of the Department of Natural Resources, for the period of July 1, 1928, to June 30, 1930.

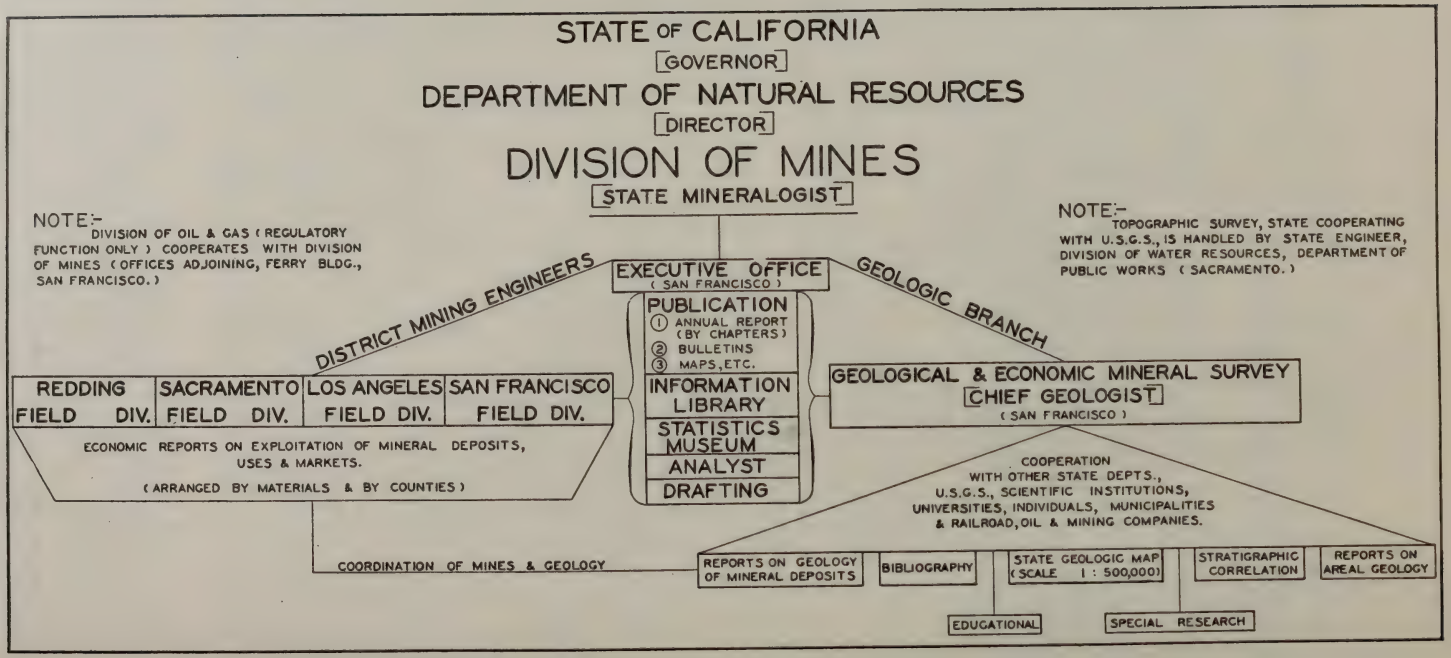
By enactment at the 1929 legislative session, sections 373*a* and 373*b* of the Political Code, relating to the Department of Natural Resources (Stats. 1927, Chap. 128), were amended changing the name of this division from "Division of Mines and Mining" to "Division of Mines," and creating a "State Mining Board" to consist of five members whose duty is to determine "general policies for the guidance of the Division of Mines." The first meeting of this new board was held in Sacramento, April 10, 1930, at which time an outline of policy and procedure was adopted. Subsequently two meetings were held in San Francisco, the budget for the coming biennium for the division and the geological survey being the principal matter considered and approved for recommendation.

The sixteenth of April, 1930, marked the 50th anniversary of the signing by Governor George C. Perkins (later United States Senator for California) of the bill introduced in the legislature by Assemblyman Joseph Wasson of Mono and Inyo counties, by which the State Mining Bureau was created, with headquarters in San Francisco. Under the authority of that act, Mr. Henry G. Hanks was shortly thereafter commissioned the first "State Mineralogist" of California.

Previously there had been two short-lived "geological surveys" in this state: the first under John B. Trask as State Geologist, 1853–1856; the second under J. D. Whitney, 1860–1873. The fundamental idea underlying the creation of the State "Mining Bureau" was that it should be concerned primarily with an economic development survey of California's mineral resources and their utilization rather than solely as a "geological" survey. Provision was also made, however, in the organic act that geology should be included in the work of the bureau.

The following have served as State Mineralogist: Henry G. Hanks, 1880–1886; Wm. Irelan, 1886–1893; J. J. Crawford, 1893–1897; A. S. Cooper, 1897–1901; Lewis E. Aubury, 1901–1911; Wm. H. Storms, December, 1911-February, 1913; Fletcher Hamilton, 1913–1923; Lloyd L. Root, February, 1923–July, 1928; the incumbent, since August 1, 1928.

Besides the main headquarters with offices in the Ferry Building, San Francisco, including the library, laboratory, and mineral exhibits, district mining engineers are stationed with offices at Sacramento, Los Angeles and Redding. Reports and bulletins to a total number of over one hundred have been published from time to time describing in detail (with maps, charts, and photographs) the varied mineral substances available in this great commonwealth of California—their loca-


STATE OF CALIFORNIA
GOVERNOR
DEPARTMENT OF NATURAL RESOURCES
DIRECTOR
DIVISION OF MINES
STATE MINERALOGIST
NOTE:- DIVISION OF OIL & GAS (REGULATORY FUNCTION ONLY) COOPERATES WITH DIVISION OF MINES (OFFICES ADJOINING, FERRY BLDG., SAN FRANCISCO.)
NOTE:- TOPOGRAPHIC SURVEY, STATE COOPERATING WITH U.S.G.S., IS HANDLED BY STATE ENGINEER, DIVISION OF WATER RESOURCES, DEPARTMENT OF PUBLIC WORKS (SACRAMENTO.)
DISTRICT MINING ENGINEERS
EXECUTIVE OFFICE (SAN FRANCISCO)
GEOLOGIC BRANCH
PUBLICATION
① ANNUAL REPORT (BY CHAPTERS)
② BULLETINS
③ MAPS, ETC.
INFORMATION LIBRARY
STATISTICS MUSEUM
ANALYST
DRAFTING
REDDING FIELD DIV.
SACRAMENTO FIELD DIV.
LOS ANGELES FIELD DIV.
SAN FRANCISCO FIELD DIV.
ECONOMIC REPORTS ON EXPLOITATION OF MINERAL DEPOSITS, USES & MARKETS.
(ARRANGED BY MATERIALS & BY COUNTIES)
GEOLOGICAL & ECONOMIC MINERAL SURVEY
CHIEF GEOLOGIST
(SAN FRANCISCO)
COOPERATION WITH OTHER STATE DEPTS., U.S.G.S., SCIENTIFIC INSTITUTIONS, UNIVERSITIES, INDIVIDUALS, MUNICIPALITIES & RAILROAD, OIL & MINING COMPANIES.
COORDINATION OF MINES & GEOLOGY
REPORTS ON GEOLOGY OF MINERAL DEPOSITS
BIBLIOGRAPHY
STATE GEOLOGIC MAP (SCALE 1 : 500,000)
STRATIGRAPHIC CORRELATION
REPORTS ON AREAL GEOLOGY
EDUCATIONAL
SPECIAL RESEARCH

tion, character, transportation facilities, state of development, utilization, and other pertinent data. At the present time, along with these economic surveys, the State Division of Mines has under way a new and comprehensive geological survey of California, made possible by a special item in the budget for the current biennium. One feature of this survey will be the preparation of a new geologic map of the entire state.

By an executive order signed May 29, 1929, the "Department of Petroleum and Gas" was transferred from the Division of Mines and Mining to the status of a separate division under the Department of Natural Resources, and designated "Division of Oil and Gas." Both divisions continue to function side by side and maintain joint offices as before.

During the calendar year 1928, there was reported commercial production of fifty-four different mineral substances, having a total value in the crude state of $332,714,233. In 1929, the value increased nearly a hundred million dollars, to a total of $432,248,228, for a like number of fifty-four substances. The increase is principally creditable to petroleum, but advances were also made by natural gas, copper, mineral water, diatomaceous earth, granite, quicksilver, salt, and soda. There were a few decreases, notably cement, borax, gold, and others.

The outstanding event during the period under review was the establishing within the Division of Mines of the geologic branch provided for by special item in the budget for the beginning of a comprehensive geological and economic mineral survey. The work of this branch is being based upon an anticipated 10-year program. The first job in this program has been to catalogue, to coordinate, and to evaluate the scattered geological work that has been done thus far by various agencies both governmental and private, published and unpublished. This was necessary in order to avoid duplication or repetition in areas already covered by competent geological investigations, such as by the United States Geological Survey, the State Division of Mines, certain of the universities, the Southern Pacific Railroad Company, and certain of the major oil companies.

These and some private individuals have all been most cordial and helpful in cooperation in this work, and have or will give to us data that would cost the state from a half million to possibly a million dollars to duplicate in original field work. As a part of their contribution to the preparation of the new geologic map of California which is one of the major items on the program, the U. S. Geological Survey staff has already begun compilation and reduction to a common scale of all of the geological maps which have been issued by their organization.

Preparation of a bibliography of published papers on Californian geology is another important item in cataloguing such data. As Dr. Solon Shedd, librarian of the Branner Memorial (geological) Library at Stanford University, and a former state geologist of Washington, already had such a bibliography under way we contracted with him to complete it and the Division of Mines will publish it as a special bulletin. It is now in the hands of the printer.

Field studies are being carried on by professors and graduate students in the geological departments of our universities. They are giving their time and this division is reimbursing them in whole or in part for their field expenses. In this way, the state is obtaining competent reports at

practically only half the expense. In fact, the state is getting two and three for one in some instances where these men have already spent the time of previous field seasons on their areas, and which results they are donating to the cause without added remuneration.

During the summer field seasons of 1929 and 1930, work has been carried on in the following areas:

1. A detailed geologic survey of the Weaverville quadrangle (in Trinity and Shasta counties) by Dr. N. E. A. Hinds, assistant professor of geology, University of California.

2. A geologic study of the Shasta quadrangle (in Siskiyou, Shasta, and Trinity counties) with special reference to economic developments, by Mr. Charles V. Averill, district mining engineer of the State Division of Mines. An areal geologic map of the Shasta quadrangle has been supplied by the geological department of the Southern Pacific Company, and Mr. Averill is coordinating this work with that of his own.

3. A detailed geologic survey of the Searles Lake quadrangle (in San Bernardino, Inyo, and Kern counties) by Dr. Carlton D. Hulin, associate professor of geology, University of California.

4. A detailed geologic survey of the Elizabeth Lake quadrangle (in Los Angeles and Kern counties) by Mr. Edward C. Simpson of the University of California.

5. A detailed geologic survey of the San Jacinto quadrangle south of San Gorgonio Pass (in Riverside County) by Mr. Donald M. Fraser of Columbia University.

6. A detailed geologic survey of an area in San Bernardino County including the Ship, Marble, and Providence mountains, by Mr. John C. Hazzard of the University of California.

7. A detailed geologic survey of an area in San Bernardino County including the Newberry Mountains, by Mr. Dion Gardner of the University of California.

8. A detailed geologic survey of an area on the east flank of the Sierra Nevada in Mono County by Mr. Evans B. Mayo, formerly of Stanford University, but now of Cornell University.

9. A detailed geologic survey and study of the mineral deposits of the Minarets district in northeastern Madera County by Mr. Homer Erwin of the University of California.

10. A detailed geologic survey of the Sebastopol and Duncans Mills quadrangles which lie west of the Santa Rosa quadrangle (in Sonoma and Marin counties) by Mr. F. A. Johnson of the University of California.

11. An underground geologic study of the deeper mine workings in the Grass Valley district by Mr. Robert L. Loofbourow of Stanford University, who is working as an assistant to the U. S. Geological Survey in a cooperative arrangement with the state.

12. An underground geologic study of the coast tunnels of the Hetch Hetchy aqueduct (San Joaquin and Alameda counties) by Mr. George L. Green of Stanford University.

The results of these investigations will be issued as special reports, but in most cases they will also serve materially in adding new information to the geologic map of the state. This map, when completed, will give a much more accurate and clearer understanding of the natural

features of California than has ever yet been shown. It is to be issued in three separate parts so that the completion of the entire map will not delay publication of finished portions.

In the normal, developmental program of the division concerned primarily with the economic mineral resources, the surveys have proceeded on the basis of county areas. The personnel was increased in 1928 by an additional mining engineer in the Los Angeles office, and by again stationing an engineer at Redding, where there had previously been a district office but which was discontinued in 1923. Surveys were completed and the reports published during the biennium on the mineral resources of the following counties: Butte, Tehama, Madera, Plumas, Kern, Lassen, Modoc, Napa, San Francisco, San Mateo, Sierra, Colusa, Fresno, Lake, Glenn, Alameda, Mendocino, Riverside, Santa Clara, Nevada.

A new series of surveys and bulletins thereon has been begun, covering principally the nonmetallic commercial minerals, and is being handled on a state-wide basis, by substances. In this list, reports on the barite resources of California, and on mineral paint pigments have been published. The text for the special bulletin on the American Mining Law on which Mr. A. H. Ricketts of the San Francisco Bar has been working for several years, has been completed and placed in the printer's hands. It is expected that it will be ready for distribution before the close of this calendar year.

Publications.

Publications issued, July 1, 1928, to June 30, 1930:

July and October chapters of State Mineralogist's Report XXIV, 1928. Among the more important subjects included were:

Mineral Resources of Butte, Tehama, Madera, and Plumas counties.

Special articles on: "Quartz Crystals"; "Notes on the Law of Mining Locations and Lands Open to Mining in California"; "Biennial Report of the State Mineralogist."

State Mineralogist's Report XXV (1929), containing:

Mineral Resources of Kern, Lassen, Modoc, Napa, San Francisco, San Mateo, Sierra, Colusa, Fresno, Lake, Glenn, Alameda, Mendocino, Riverside counties.

Special articles on: "Mammoth Tusks found near Oroville, California"; "Mineral Pigment Tests"; "American Manganese Producers Association"; "Some Special Methods and Machines for Recovery of Gold and Platinum in Placer Deposits"; "Ore-Buyers' License Act"; "Assessment Work on Mining Claims within Withdrawn Areas"; "Surface Rights of a Mineral Locator within the National Forests"; "'Mine' and 'Mineral' defined for Mining Bureau Act"; "'Division of Mines' Amendment."

January and April chapters of State Mineralogist's Report XXVI (1930), containing:

Mineral Resources of Santa Clara and Nevada counties.

Special articles on: "Barite in California"; "Mercury deposits of Coso Range, Inyo County"; "Aerial Photography and Its Importance to California Geologists"; "Mineral Paint Materials in California"; "Assessment Work on Mining Claims within Withdrawn Areas."

Bulletin 101. California Mineral Production for 1927, by Henry H. Symons, 311 pages, 11 illustrations. Contains also tables of "total recorded mineral productions" for all counties in the state.

Bulletin 102. California Mineral Production for 1928, by Henry H. Symons, 215 pages, 19 illustrations.

These two bulletins, Nos. 101 and 102, give the detailed figures of commercial production of all mineral substances in California for the calendar years 1927 and 1928, respectively.

Monthly Summary of California's Oil Field Operations, July, 1928, to June, 1929, inclusive, being chapters of the Fourteenth Annual Report of the State Oil and Gas Supervisor. Containing also the following special articles:

Miocene Formations in the East Side Fields of Kern County.
Production statistics of California Oil Fields.
Directory of California Oil Operators.
The Use of Hydraulic Cement in Oil Wells.
Some Useful Oil Field Tables.
Preliminary Report on the Kettleman Hills Oil Field.
Measurement of Gas Production.
Santa Fe Springs Oil Field.
Wildcat wells abandoned in 1928.
Uniform Penetration in Orderly Development of Oil Zones.
A General Discussion of Natural Gas Technology.
Controlling a Blow-out in Kettleman Hills Field.
Crooked Holes.

Present Outlook and Needs of This Division.

The most important advances economically in recent years in California and on the Pacific coast are being made in the utilization of the nonmetallic minerals—those ores or materials mined for purposes other than the extraction of their metal contents. There is a present urgent demand for accurate, authoritative, and up-to-date information on these minerals, their location, character, extent, availability, transportation facilities. Our program for the coming biennium must include the continuance of the state-wide survey of these nonmetallic resources. It is only by field studies and examinations by the engineers of the division that our information can be kept abreast of the times and reliable. Increased appropriation of funds should be allotted for such field studies and for publication of results. The same statements are true of the geological survey program. That job is a fundamental one and vitally needed as furnishing the basic data upon which to build the economic resources survey. The appropriation for the geological work should be increased to the basis of the ten-year program agreed upon two years ago; that is, at least $50,000 per year.

Respectfully submitted.

Walter W. Bradley,
State Mineralogist.

San Francisco, October 10, 1930.

OUR DECREASING GOLD SUPPLY

Mr. Alden Anderson, in an open letter to the Mining Association of California, discusses the subject of gold production as it relates to the economic and commercial structure of this country.

Mr. Anderson has achieved a business success as a fruit grower, packer and shipper, and is still a recognized authority on the fruit industry.

He served four years as Lieutenant Governor of California, and later a term as State Bank Superintendent for California. For many years he has been president of the Capital National Bank of Sacramento, and a director and officer of a number of banks in other Sacramento Valley cities.

He has recently been appointed a member of a National Committee composed of eminent economists and financiers, having for its object the stabilization of the gold standard, and as far as may be possible the prevention of fluctuation in its purchasing power.

Mr. Anderson speaks as a banker and an economist, and his position in the business and financial world gives his views greater weight than would attach to those of a man of less experience. For these reasons we feel warranted in printing his letter herein:

ALDEN ANDERSON

SACRAMENTO, CALIFORNIA

October 15, 1930.

Mr. C. S. Brooks,
Secretary, Sacramento Chapter,
Mining Association of California,
Sacramento, California.

Dear Sir:

I am sorry that I could not come in person to talk to the members of the Mining Association of Sacramento with reference to the subject of gold as it relates to our economic and commercial structure, and to tell you why, in my opinion, our government should devise and practice ways and means of assisting in a greater production of gold.

An effort to realize a perfect currency is the ambition of economists and thinkers, and after all the years, gold has been universally adopted as the best standard of value and commodity of ultimate redemption of circulating mediums of practically every important commercial country in the world. Experience, of course, taught that there must be some standard of value for the expeditious exchange of credits for all commercial countries.

Among the qualities which any ideal form of money should possess, none is more important than stability in value, and gold has possessed that quality better than any other medium. The development of rapid transit and quick communication all over the world, and the greater

ease of the exchange of commodities has made it all the more vital that the standard of value should be universally known and used, and concomitantly it is most obligatory that the volume of such standard shall be sufficient for the purpose.

The improvement in banking methods and laws, including our own Federal Reserve System, has made the present quantity of gold more available and usable at the present time, and with the regularly expanding commerce matters have gone quite well. Now, however, we are confronted with the problem of constantly increasing commerce and a greater demand from the arts and sciences for gold, and at the same time, due to the increased cost of mining and the fixed price for gold, of a constantly decreasing supply. Take California, for instance. Our total production last year was only eight million dollars, with indications of further decline, and this same trend is manifest in all gold producing regions. Estimates of the production of gold during the next ten years, prepared by a special delegation of the Financial Committee of the League of Nations, indicates the probability of a steady falling off in production after 1932, although the different authorities are not entirely in agreement as to the extent of the decline. The total figures of the probable decline as prepared by Mr. Jos. Kitchen, of England, a recognized authority on metal statistics, shows an estimated production of $405,000,000 for 1930, and of only $314,000,000 in 1940.

This can not continue if we are to rely on gold as our commodity of ultimate redemption. Now is the time to look forward and correct such tendency and not wait until the situation has arrived at a point to restrict and retard commerce and to throw this country and others into the uncertainties of political agitation and controversy as to whether the standard of value should be changed or not. Endeavor to increase the supply of gold should be started at once. Our government is intensely concerned and should be exerting itself now.

I am not a miner, nor am I interested personally in mining in any way. It is plain to me that the Federal Government should take the initiative now and commence working to the end of increasing the gold supply. It should be immediately provided that gold mining companies should pay no taxes of any kind, corporation, income, etc., and arrangement should be made to carry all compensation insurance.

The several states should be importuned to amend their laws so that no gold mining company should be compelled to pay any state or county taxes. There is no impropriety in the government doing this. The government is responsible for the maintenance of a stable and adequate financial system, backed by sufficient gold reserve at all times for its needs. You remember during the war of the energetic efforts of the government to draw in all available gold supplies. When more gold is needed, where will they get it if none is available? The states can well afford not to tax gold mines, for from the nature of the business the mines are located in areas where the normal taxes, without development, would practically amount to nothing. When development starts, men are put to work, supplies are purchased, machinery and equipment secured, and the whole community benefited. At present, the moment such development starts, the assessor gets busy, too, and full taxes have to be paid on every visible asset.

The above should be among the first steps taken. Such procedure would injure no one, would provide employment and stimulate activity in gold mining. Later, more will undoubtedly have to be done if there is not enough gold produced to keep pace with increasing needs.

It is argued by many that the government should peg the price of gold, say at $25.00 per ounce, and insist that all gold mined be delivered to the government only. The government could then distribute a quantity to the arts and sciences if they saw fit. It might be contended that if the government did this we would attract all the gold of the world here. Well, that wouldn't be so bad, for if we had all the gold we could dictate terms and absolutely control all the commerce of the world. What would happen would be that the other countries would peg the price too to keep their gold at home, and the result would be that of stimulating gold mining all over the world.

It is no idle dream, this of a possible or probable gold shortage in the not too distant future. We are all right now, governmentally and commercially, but with a decreasing gold supply, and the increasing demand outside of monetary needs, and a constantly increasing volume of trade and commerce, the trends are in the wrong direction to assure stability and adequacy for our financial purposes and needs.

We, in California, however, know that there is a possibility, with slight encouragement, of doubling our gold production for many years to come in California. This same condition undoubtedly prevails elsewhere, and thus it seems to me that the mining people are the ones to collect all facts and statistics of this matter and show clearly the point at which it becomes unprofitable to work many of our mines in California, and at which there is no stimulating influence to encourage development of new mines.

Have the facts available for use, and thus commence a campaign with the people and the government to awaken them to action before the ill effects of a diminishing gold supply shall be felt.

Very truly yours,

(Signed) Alden Anderson,
President, Capital National Bank,
Sacramento, California.

ADMINISTRATIVE

WALTER W. BRADLEY, State Mineralogist

Personnel.

There have been no changes nor additions of personnel to be noted during the past three months.

Biennial Report of State Mineralogist.

Elsewhere in this issue, under 'special articles' will be found the biennial report of the State Mineralogist to the Governor of California, containing a summary of the ground covered and work accomplished during the past two years. The outstanding feature of this period has been the establishment of the geologic branch within this division and the beginning of a properly coordinated and comprehensive geological survey of the state.

New Publications.

Mining in California (quarterly), April 1930, being Chapter 2 of State Mineralogist's Report XXVI. Price 25 cents. Contains a report on the mineral resources of Nevada County; also special articles on: 'Mineral Paint Materials in California;' and 'Assessment Work on Mining Claims within Withdrawn Areas.'

Commercial Mineral Notes, Nos. 88, 89, 90, July, August, September, 1930, respectively. These 'notes' contain the lists of 'mineral deposits wanted' and 'minerals for sale' issued in the form of a mimeographed sheet, monthly. It is mailed free to those on the mailing list for MINING IN CALIFORNIA.

Mails and Files.

The Division of Mines maintains, in addition to its correspondence files and the library, a mine file which includes original reports on the various mines and mineral properties of all kinds in California.

During each quarterly period there are several thousand letters received and answered at the San Francisco office alone, covering almost every phase of prospecting, mining and developing mineral deposits, reduction problems, marketing of refined products, and mining law. In addition to this, hundreds of oral questions are answered daily, both at the main office and the district offices, for the many inquirers who come in for personal interviews and to consult the files and library.

MINERALS AND STATISTICS

Statistics, Museum, Laboratory

HENRY H. SYMONS, Statistician and Curator

STATISTICS

Data on the 1929 production of some of California's minerals were given in both the April and July issues of MINING IN CALIFORNIA and tabulations are presented herein showing the completed totals for all substances for the year, grouped by substances and by counties. The complete annual report on mineral production of California for 1929 is now in press as Bulletin No. 103 of the State Division of Mines.

Summary for 1929.

The total value of the mineral output of California for the year 1929 was $432,248,228, being an increase of $99,533,995 over the 1928 total of $332,714,233. There were fifty-four different mineral substances, exclusive of a segregation of the various stones grouped under gems; and all but one of the fifty-eight counties of the state contributed to the list.

As revealed by the data following, the salient features of 1929 compared with the preceding year were: A large increase in the amount and total value of the petroleum output, also material advances were shown by natural gas, copper, mineral water, diatomaceous earth, granite, quicksilver, salt and soda. Decreases were registered by cement, borax, pottery clay, gold, lead, magnesite and silver. Petroleum showed an increase in value of $91,368,183. There was an increase from 231,811,465 barrels to 292,534,221 barrels, this being the largest annual production of crude oil in the history of the state. The building of pipe lines increased the demand for natural gas and the output increased from 260,887,116 M cu. ft. worth $22,260,947 to 400,192,201 M cu. ft. worth $29,067,546.

Of the metals copper increased from 25,162,304 pounds worth $3,623,360 to 33,809,258 pounds worth $5,941,799, and quicksilver from 7107 flasks worth $844,649 to 10,152 flasks worth $1,195,705; while gold output decreased in value from $10,875,315 to $8,526,703; lead decreased from 1,882,795 pounds worth $109,102 to 1,428,777 pounds worth $90,014, and silver from 1,478,771 fine ounces worth $865,081 to 1,176,895 fine ounces worth $627,285. The increase in copper was due to higher prices for that metal over the preceding year, but this did not hold true with lead, silver and zinc, as their prices were higher but not enough to justify the reopening of mines shut down in 1928.

Of the structural materials, granite increased from a total value of $763,996 to $1,169,271 and miscellaneous stone from $17,332,110 to $17,840,159, while cement decreased from 13,625,231 barrels worth $24,463,287 to 12,794,729 barrels worth $21,038,565, and this group, as a whole, was the only one to show a decrease. The industrial group in general showed increases, with mineral water leading the list, with an increase from 25,049,002 gallons worth $1,304,969 to 27,032,083 gallons and $2,040,615. Of the saline group, salt increased from 340,480 tons worth $1,024,656 to 392,039 tons worth $2,665,436, and soda from 80,838 tons worth $1,469,297 to 90,646 tons worth $1,838,657, while

borates decreased in value from $3,378,552 to $3,312,085, but showed an increased quantity from 109,722 tons to 144,678 tons.

The distribution of the 1929 output of California by substances is shown in the following tabulation:

Substance	*Amount*		*Value*
Barytes	26,796	tons	$168,829
Bituminous rock	3,320	tons	14,360
Borates	144,678	tons	3,312,085
Brick and hollow building tile	-----		5,607,410
Cement	12,794,729	bbls.	21,038,565
Chromite	327	tons	5,025
Clay (pottery)	839,949	tons	1,127,517
Coal	450	tons	2,476
Copper	33,809,258	lbs.	5,941,799
Dolomite	58,644	tons	156,928
Feldspar	13,377	tons	78,404
Fuller's earth	15,541	tons	170,563
Gems	-----		26,850
Gold	-----		8,526,703
Granite	-----		1,169,271
Gypsum	140,844	tons	396,951
Lead	1,428,777	lbs.	90,014
Lime	42,834	tons	417,101
Limestone	162,315	tons	557,617
Magnesite	47,769	tons	488,014
Marble (onyx and travertine)	-----		93,661
Mineral paint	467	tons	2,820
Mineral water	27,032,083	gal.	2,040,615
Natural gas	400,129,201	M cu. ft.	29,067,546
Petroleum	292,534,221	bbls.	321,366,863
Platinum	212	fine oz.	14,416
Pumice and volcanic ash	10,449	tons	76,123
Pyrites	79,169	tons	363,717
Quicksilver	10,152	flasks	1,195,705
Salt	392,039	tons	2,665,436
Sandstone	177,655	cu. ft.	49,881
Silica	18,686	tons	79,210
Silver	1,176,895	fine oz.	627,285
Soapstone and talc	18,676	tons	193,493
Soda	90,646	tons	1,838,657
Stone, miscellaneous [a]	-----		17,840,159
Tungsten	150	tons	106,480
Unapportioned [b]	-----		5,329,679
Total value			$432,248,228

[a] Includes macadam, ballast, rubble, riprap, sand and gravel.

[b] Includes asbestos, bromine, calcium chloride, diatomaceous earth, magnesium salts, manganese, mica (sericite), potash, slate, sillimanite-andulasite-cyanite group, tube-mill pebbles, sulphur and tin.

Distribution by counties is given in the following tabulation:

Alameda	$3,626,723	Placer	266,347
Alpine	33,013	Plumas	5,137,968
Amador	2,498,217	Riverside	5,401,860
Butte	584,319	Sacramento	2,247,302
Calaveras	2,522,259	San Benito	1,908,462
Colusa	42,570	San Bernardino	11,210,652
Contra Costa	1,827,956	San Diego	1,447,287
Del Norte	84,263	San Francisco	75,245
El Dorado	367,500	San Joaquin	789,891
Fresno	2,413,495	San Luis Obispo	191,084
Glenn	81,516	San Mateo	3,672,779
Humboldt	293,678	Santa Barbara	16,407,136
Imperial	509,832	Santa Clara	963,478
Inyo	2,296,210	Santa Cruz	3,327,633
Kern	38,809,239	Shasta	1,751,196
Kings	4,259,833	Sierra	390,402
Lake	387,700	Siskiyou	229,789
Lassen	88,698	Solano	66,421
Los Angeles	243,568,275	Sonoma	351,383
Madera	1,027,410	Stanislaus	388,235
Marin	470,002	Sutter	-----
Mariposa	244,017	Tehama	14,480
Mendocino	59,000	Trinity	525,874
Merced	1,110,498	Tulare	296,881
Modoc	30,996	Tuolumne	371,520
Mono	212,831	Ventura	34,043,899
Monterey	354,858	Yolo	14,400
Napa	649,822	Yuba	1,830,371
Nevada	1,980,028		
Orange	28,491,495	Total	432,248,228

MUSEUM

The Museum of the State Division of Mines possesses an exceptionally fine collection of rocks and minerals of both economic and academic value. It ranks among the first five of such collections in North America and contains not only specimens of most of the known minerals found in California, but much valuable and interesting material from other states and foreign countries as well.

Mineral specimens suitable for exhibit purposes are solicited, and their donation will be appreciated by the State Division of Mines as well as by those who utilize the facilities of the collection.

The exhibit is daily visited by engineers, students, business men, and prospectors, as well as tourists and mere sightseers. Beside its practical use in the economic development of California's mineral resources, the collection is a most valuable educational asset to the state and to San Francisco.

LABORATORY

FRANK SANBORN, Mineral Technologist

Practically all of the gold found in California exists as the native metal, either as free gold in the quartz or else mechanically mixed with sulphides. Gold in the sulphide of iron, pyrite (auriferous pyrite) is common, and auriferous pyrite is a source of much of the gold produced in the state.

At least nine different tellurides have been reported as occurring in the state, but in small amounts only. Petzite is the commonest form found.

A characteristic reaction for all tellurides is the deep purplish-red color obtained by boiling a small amount of the powdered mineral in a few drops of concentrated sulphuric acid. The tellurides are heavy and can be concentrated, dried and tested in this manner.

Petzite and hessite are lead-gray or steel-gray to black in color, while sylvanite and calaverite are yellowish silver-gray to bronze-yellow in color. In this State more or less free gold is practically always associated with the gold tellurides, so in panning, free gold is usually seen associated with a dark colored concentrate which is the telluride of gold.

Small amounts of tellurides have been observed in a number of different counties, and it is likely that they may be found in any of the state's gold-bearing districts.

Recently a high-grade sample of petzite was received from Grass Valley, but no large amount was apparently found. Tellurides seem to be sparingly disseminated through the veins.

Judging from the many samples being received for gold determinations, prospecting for this metal is again very active. Requests are made often for tellurium determinations and sometimes the sample submitted is merely barren rock. There is an impression, apparently, that the tellurides may be present without a showing of visible mineralization.

LIBRARY

HERBERT A. FRANKE, Librarian

In addition to the numerous standard works, authoritative information on many phases of the mining and mineral industry is constantly being issued in the form of reports and bulletins by various government agencies.

The library of the Division of Mines contains some five thousand selected volumes on mines, mining and allied subjects, and it is also a repository for reports and bulletins of the technical departments of federal and state governments and of educational institutions, both domestic and foreign.

It is not the dearth of the latter publications, but rather a lack of knowledge of just what has been published and where the reports may be consulted or obtained, that embarrasses the ordinary person seeking specific information.

To assist in making the public acquainted with this valuable source of current technical information, MINING IN CALIFORNIA contains under this heading a list of all books and official reports and bulletins received, with names of publishers or issuing departments.

Files of all the leading technical journals will be found in the library, and county and state maps, topographical sheets and geological folios. Current copies of local newspapers published in the mining centers of the state are available for reference.

The library and reading room are open to the public during the usual office hours, when the librarian may be freely called upon for all necessary assistance.

OFFICIAL PUBLICATIONS RECEIVED

Governmental.

U. S. Geological Survey:

Professional Papers:

158—Shorter Contributions to General Geology.
159—The Upper Cretaceous Floras of Alaska.

Bulletins:

810—Mineral Resources of Alaska, 1927. By P. S. Smith and others.
812—Contributions to Economic Geology, 1929. Part II, Mineral Fuels.
814—Geology and Ore Deposits of the Wood River Region, Idaho. By D. F. Hewett.
815—Geology and Mineral Resources of Northwestern Alaska. By P. S. Smith and J. B. Mertie, Jr.

Water Supply Papers:

630—The Great Basin.
631—Pacific Slope Basins in California.
634—North Pacific Slope Basins.
636—Contributions to the Hydrology of the U. S., 1929.

Hawaiian Volcano Observatory:

Vol. XVI, Nos. 11–12.
Vol. XVII, Nos. 1–7.

U. S. Coast and Geodetic Survey:

No. 167—Progress of Seismological Investigations in the U. S., July 1, 1927, to January 1, 1930.

U. S. Bureau of Mines:

Technical Papers:

470—Results of Air Repressuring and Engineering Study of Williams Pool, Putnam-Moran District, Callahan County, Texas. By H. B. Hill.
473—Chemistry of Leaching Chalcocite. By J. D. Sullivan.
476—Stock Distribution and Gas—Solid Contact in the Blast Furnace. By C. C. Furnas and T. L. Joseph.
477—A Study of the Lubricant Fractions of Cabin Creek (W. Va.) Petroleum.

Bulletins:

315—Construction and Operation of the Bureau of Mines Experimental Oil-Shale Plant, 1925–1927. By M. J. Gavin and J. S. Desmond.
317—Rock Strata Gases of the Cripple Creek District, Colo., and their Effect on Mining.
318—Innovations in Copper Leaching Employing Sulphate-Sulphuric Acid. By H. E. Keyes.
322—Effect of Vacuum on Oil Wells. By B. E. Lindsly and W. B. Berwold.

Division of Mineral Statistics:

Map showing Value of 1928 Mine Production of Gold, Silver, Copper, Lead, Zinc, and Iron Ore of the U. S. by States and Districts Yielding $100,000 or more.

Mineral Resources of the U. S.:

Arsenic in 1929. By V. C. Heikes.
Asphalt and Related Bitumens in 1928. By A. H. Redfield.
Bauxite and Aluminum in 1928.
Cement in 1928. By H. W. Bagley.
Coal in 1928. By F. G. Tryon, O. E. Kiessling and T. Mann.
Coke and By-products in 1928. By F. G. Tryon and H. L. Bennit.
Fluorspar and Cryolite in 1929. By H. W. Davis.
Fuel Briquets in 1929. By O. E. Kiessling and J. M. Corse.
Gold, Silver, Copper, Lead and Zinc in Idaho and Washington in 1928. By C. N. Gerry.
Gold, Silver, Copper, Lead and Zinc in Montana in 1928. By C. N. Gerry.
Gold, Silver, Copper, Lead and Zinc in Nevada in 1928. By V. C. Heikes.
Gold, Silver, Copper, Lead and Zinc in New Mexico and Texas in 1928. By C. W. Henderson.
Gold, Silver, Copper and Lead in South Dakota and Wyoming in 1928. By C. W. Henderson.
Lead in 1928. By E. W. Pehrson.
Mica in 1928. By B. H. Stoddard.
Mineral Resources of the U. S., 1927. Parts I and II.
Mineral Resources of the U. S., 1929. (Preliminary Summary.)
Petroleum in 1928. By G. R. Hopkins and A. B. Coons.

Economic Paper:

8—Summarized Data of Silver Production. By C. W. Merrill.

Reports of Investigations:

3008—Laboratory and Field Tests of a Permissible Indicating Methane Detector. By A. B. Hooker, W. J. Fene, and R. D. Currie.
3015—Rock-Dusting in the Coal Mines of the State of Washington. By S. H. Ash and John G. Schoning.
3016—The Lower Limits of Inflammability of Natural Gas-Air Mixtures in a Large Gallery. By J. E. Crawshaw.
3017—A New Flame Safety Lamp Testing and Demonstration Apparatus. By W. P. Yant, L. B. Berger, and G. S. McCaa.
3018—Gravity Concentration on Certain Florida Phosphatic Sands. By H. M. Lawrence and R. G. O'Meara.
3022—The Use of Boiler Feed-Water Heaters With Steam-Powered Rotary Drilling Equipment. By C. E. Reistle, Jr.

3023—Increased Recoveries of Phosphate in the Land-Pebble District of Florida. By H. M. Lawrence.
3024—Dissolution of Various Manganese Minerals. By C. W. Davis.
3025—Active List of Permissible Explosives and Blasting Devices Approved Prior to June 30, 1930.
3027—Acrolein as a Warning Agent for Detecting Leakage of Methyl Chloride from Refrigerators. By W. P. Yant, H. H. Schrenk, F. A. Patty, and R. R. Sayers.
3028—Some Experiments on the Initiation of Coal-Dust Explosions by Gas Explosions. By G. S. Rice, H. P. Greenwald, and H. C. Howarth.
3029—Official Changes in the Active List of Permissible Explosives and Blasting Devices for August, 1930.

Information Circulars:

6279—Natural-Gasoline Plants in the United States. By G. R. Hopkins and E. M. Seeley.
6294—Methods and Cost of Mining Fluorspar at Rosiclare, Ill. By Edwin C. Reeder.
6295—Mining Laws of Costa Rica. By A. D. Garman.
6296—Danger to the Public from Abandoned Mine Workings and Other Property. By F. S. Crawford.
6297—Mining Laws of Japan. By A. D. Garman.
6298—Mining Laws of Brazil. By A. D. Garman.
6299—Hazards and Protection of Underground Transformer Installations. By D. J. Parker.
6300—Some Hazards of Conveyor Loading in Coal Mines. By C. W. Jeffers.
6301—An Automatic Electric Man-Hoist for Slopes or Inclines. By S. H. Ash and E. M. Brooks.
6302—Mining Laws of Nicaragua. By A. D. Garman.
6303—Leaching Practice and Costs at the New Cornelia Mine of the Calumet & Arizona Mining Co., Ajo, Ariz. By George A. Bell.
6304—Privately Owned Mine-Rescue Stations. By R. D. Currie and C. W. Owings.
6306—Nomographs for Calculating the Second Derivatives of the Force of Gravity Potential Obtained by Observations Made with a Torsion Balance at 5 Azimuths. By W. Ayvazoglou, translated from the original Russian of A. Stepanoff.
6307—Mining Methods and Costs at the Pilares Mine, Pilares de Nacozari, Sonora, Mexico. By Everard Leland.
6308—Mining Laws of Latin America. By A. D. Garman.
6310—Selected List of Bureau of Mines Publications Covering Safety Studies and Activities of the Electrical Section. By L. C. Ilsley.
6311—Mining Methods and Costs at the Argonaut Mine, Amador County, Calif. By Wm. O. Vanderburg.
6312—Radium. By Paul M. Tyler.
6313—Marble. By Oliver Bowles and D. M. Banks.
6314—Milling Methods and Costs at the Northern Idaho Mills of the Bunker Hill and Sullivan Mining and Concentrating Co. By J. S. Handy.
6315—What the Coal Miner Can Do to Prevent Injury from Falls of Roof. By J. W. Paul.
6316—Systematic Timbering Rules at the Washington Coal Mines. By S. H. Ash.
6317—Selenium and Tellurium. By R. M. Santmyers.
6318—The Grounding of Electric Systems in and Around Mines. By L. C. Ilsley.
6319—Milling Methods and Costs at the Concentrator of the Magma Copper Co., Superior, Ariz. By J. H. Rose and J. C. McNabb.
6320—Milling Methods and Costs at the Concentrator of the Chief Consolidated Mining Co., Eureka, Utah. By G. H. Wigton.
6321—Monazite, Thorium, and Cerium. By R. M. Santmyers.
6322—Mining Methods and Costs at the Teck-Hughes Gold Mines (Ltd.), Kirkland Lake, Ontario. By R. J. Henry.
6323—Fire-Fighting Equipment and Organization of the Madison Coal Corporation, Glen Carbon, Madison County, Ill. By A. U. Miller.

6325—Underground Mining Practice and Costs at a Mesabi Range (Minnesota) Mine Using the Top-Slicing System. By W. D. Haselton.
6328—Tantalum (and Columbium). By E. P. Youngman.
6329—Sulphur—General Information. By Robert H. Ridgway.
6330—Some Hazards of Transporting Explosives in Automobile Trucks. By C. W. Owings and J. M. Harrington.
6331—Cobalt. By P. M. Tyler.
6341—Geophysical Abstracts No. 15. By Frederick W. Lee.
6347—List of Permissible Mine Equipment. By L. C. Ilsley.
6355—Geophysical Abstracts No. 16. By Frederick W. Lee.

Recent Articles on Petroleum and Allied Substances:
May, 1930.
June, 1930.
July, 1930.

U. S. Bureau of Foreign and Domestic Commerce:

Monthly Summary of Foreign Commerce of the U. S.:
Part 2, April, 1930.
Part 2, May, 1930.
Part 1, June, 1930.
Part 1, July, 1930.

U. S. 71st Congress, 2d Session:
Tariff Act of 1930. Public Law No. 361.

California Fish and Game:
Vol. 16, No. 3.

California State Department of Public Works:

California Highways and Public Works:
July-August, 1930.

Division of Water Resources:
Bulletin No. 23—Report of Sacramento-San Joaquin Water Supervisor, 1924–1928. By H. M. Stafford.

California State Library:
Vol. 25, No. 3.

Colorado Bureau of Mines:
Annual Report for the year 1929.

Idaho Bureau of Mines and Geology:
Pamphlet No. 34—The Geology and Mineral Resources of the Region about Orofino, Idaho. By A. L. Anderson.

Illinois Department of Mines and Minerals:
48th Coal Report of Illinois, 1929.

Missouri Bureau of Mines:
42d Annual Report, 1929. By F. G. Fenix.

New Jersey Department of Conservation and Development:
Bulletin No. 34—The Mineral Industry of New Jersey for 1928. By M. E. Johnson.

Oklahoma Geological Survey:
Bulletin 40, Vol. II, with maps.
Bulletin 40, Vol. III, with maps.

Pennsylvania Geological Survey:
Fourth Series, Bulletin G 3: Pennsylvania Caves. By R. W. Stone.

Scientific and Industrial Research Council of Alberta:
Tenth Annual Report, 1929.

Argentina Direccion General de Minas, Geologia e Hidrologia:
No. 79, Memoria.

Australian Museum:
Vol. XVII, Nos. 7, 8.

Canada Department of Mines:
No. 710—Investigation of Mineral Resources and the Mining Industry, 1928.
No. 711—Investigations in Ore Dressing and Metallurgy.

Great Britain Department of Scientific and Industrial Research:
Wells and Springs of Worcestershire.
Wells and Springs of Gloucestershire.
The Geology of the Alnwick District.
Geological Maps of Alnwick, Maryport, Whitehaven, Chesterfield, and Ordance Survey of Scotland.

Great Britain Geological Survey:
Part 1, Summary of Progress, 1929.

Secretaria de Industria, Commercio y Trabajo, Mexico:

Boletin del Petroleo:
Vol. XXVIII, No. 3.
Vol. XXVIII, Nos. 4 y 5.
Vol. XXVIII, No. 6.
Vol. XXIX, No. 1.

Ministero Delle Corporazioni, Libreria:
Anno XXXIX, No. 50.

New South Wales Department of Mines:
Annual Report, 1929.

Quebec Bureau of Mines:
Annual Report, 1929, Parts A and B.

Queensland Geological Survey:
No. 278—The Queensland Upper Palaeozoic Succession. By J. H. Reid.
Annual Report, 1929.

South Australia Department of Mines:
No. 14—Geological Structure and Other Factors in Relation to Underground Water Supply in Portions of South Australia.
No. 51—Mining Review.

Transvaal Chamber of Mines:
40th Annual Report, 1929.
Wilwatersrand Gold Field.

Western Australia Geological Survey:
Bulletin 94—Geology and Ore Deposits of the Boulder Belt, Kalgoorlie. By F. L. Stillwell.

Societies and Educational Institutions.

Academy of Natural Sciences of Philadelphia:
1929 Year Book.

American Association of Petroleum Geologists:
Vol. 14, No. 7.
Vol. 14, No. 8.
Vol. 14, No. 9.

American Geographical Society of New York:
July, 1930.

American Philosphical Society:
Vol. LXIX, No. 5.
Vol. LXIX, No. 6.

Canadian Institute of Mining and Metallurgy:
No. 219.
Transactions, Vol. XXXII, 1929.
No. 220.
No. 221.

Chile-American Association:
Chile in 1930.

Cleveland Museum of Natural History:
Annual Report, 1929.

Colombia Museo Nacional:
Notas Adicionales Sobre los Minerales y las Rocas de Colombia. Por R. T. Codazzi.

Colorado Scientific Society:
Vol. 12, No. 5.
Vol. 12, No. 6.

Economic Geology:
Vol. XXV, No. 5.
Vol. XXV, No. 6.

Far Eastern State University:
Series 3, No. 8.
Series 5, Nos. 5, 8.
Series 7, Nos. 7, 10, 12, 13.
Series 15, No. 6.

Harvard University:
XIX—Geology and Geography. By W. M. Davis and R. A. Daly.

Institution of Mining and Metallurgy, London:
No. 309, June, 1930.
No. 310, July, 1930.
No. 311, August, 1930.

Leidsche Geologische Mededeelingen:
Deel III, Aflevering 5, II, 1930.

Library of Congress:
Vol. 21, No. 2.
Vol. 21, No. 3.
Vol. 20, Title-Page and Index.
Vol. 21, No. 4.
Vol. 21, No. 5.

Mineralogical Society of America:
Vol. 15, No. 7.
Vol. 15, No. 8.

Mining and Metallurgical Society of America:
Bulletin 211.
Bulletin 212.

Naturforschenden Gesellschaft zu Freiburg i Br.
Report.

Naturwissenschaftliche Zeitschrift:
Lotos, Band 77, Heft 1–12.

New Mexico School of Mines:
Bulletin No. 5—Geologic Literature of New Mexico. By T. P. Wootton.

New York Academy of Sciences:
Vol. XXXII, pp. 1–52, pp. 53–86, pp. 87–220.

Northwest Science:
Vol. IV, No. 1.

Pennsylvania State College:
Bulletin 36—Studies at the Sewage Treatment Plant.

Philippine Journal of Science:
Vol. 42, No. 3.
Vol. 42, No. 4.
Vol. 43, No. 1.
Vol. 43, No. 2.

Real Academia de Ciencias y Artes de Barcelona:
Vol. VI, No. 1.
Vol. XXII, No. 1.
Tomo XXI.

Royal Society of South Australia:
Vol. LIII.

Tohoku Imperial University, Japan:
Vol. XIII, No. 3.
Vol. XIV, No. 1.

U. S. S. R. Geological and Prospecting Service:
Vol. XLIX, No. 3, 1930.
Vol. XLIX, No. 4, 1930.

University of California, Geology Department:
Vol. 19, No. 6—Structure of the San Gabriel Mountain, North of Los Angeles, California. By M. L. Hill.
Vol. 19, No. 7—Osteology and Affinities of Boraphagus. By W. D. Matthew and R. A. Stirton.
Vol. 19, No. 8—A New Genus of Soricidae from the Barstow Miocene of California. By R. A. Stirton.
Vol. 19, No. 9—Allocyou, a New Canid Genus from the John Day Beds of Oregon. By C. W. Merriam.
Vol. 19. No. 10—The Quartz Basalt Eruptions of Cinder Cone, Lassen Volcanic National Park, California. By R. H. Finch and C. A. Anderson.
Vol. 19, No. 11—The Classification and Correlation of the Pre-Cambrian Rocks. By A. C. Lawson.

University of Nevada:
Vol. XXIV, No. 4—The Underground Geology of the Western Part of the Tonopah Mining District, Nevada. By T. B. Nolan.

University of Upsala, Sweden:
Vol. XXII.

Western Society of Engineers:
Vol. XXXV, No. 4.

Books:

Synthetic Fuels and Lubricating Oils. By A. W. Nash.
Mineralogy of the Adirondack Feldspars. By T. F. W. Barth.
Optical Properties of Mixed Crystals. By T. F. W. Barth.
On the Occurrence of Beryllium in the Zinc Deposits of Franklin, New Jersey. By C. Palache and L. H. Bauer.
Geology of the Panamint Silver District, California. By F. MacMurphy.
Petroleum Engineering Hand Book.
Conservation of Our Natural Resources. By Van Hise and Havemeyer.
Bibliography on Magnesite Deposits of the World. By K. Niinomy.
Freezing and Thawing of Soils as Factors in the Destruction of Road Pavements. By S. Taber. (Published in Vol. II, No. 6, by the U. C. Department of Agriculture.)
The Mechanics of Frost Heaving. By S. Taber.

John Hays Hammond Public Mining Library:

Principles of Metallurgy of Ferrous Metals. By Leon Cammen.

Maps:

Oregon:

Topographic Map of North Central Oregon. By E. T. Hodge.

Kansas:

Surface Features of Kansas.
Geologic Map of Kansas.

U. S. Topographic Sheets:

Arkansas—Louisana:

El Dorado Quadrangle.

California:

Inglewood Quadrangle.
Pond Quadrangle, Kern County.
Wasco Quadrangle, Kern County.
McFarland Quadrangle, Kern County.
Bena Quadrangle, Kern County.
Edison Quadrangle, Kern County.
Coles Levee Quadrangle, Kern County.
Fairfax School Quadrangle, Kern County.
Gosford Quadrangle, Kern County.
Arroyo Siquis Quadrangle, Los Angeles County.

Current Magazines on File.

For the convenience of persons wishing to consult the technical magazines in the reading room, a list of those on file is appended:

Architect and Engineer, San Francisco.
Asbestos, Philadelphia, Pa.
Asbestology, Canadian Asbestos Co., Montreal, Canada.
Brick and Clay Record, Chicago.
Canadian Mining Journal, Gardenvale, Que.
Caterpillar, San Leandro, Cal.
Chemical Engineering and Mining Review, Melbourne, Australia.
Chemical and Metallurgical Engineering, New York City.
Commerce Reports, Washington, D. C.
Colorado School of Mines, Golden, Colo.
Cooper–Bessemer Monthly, Grove City, Pa.
Engineering and Mining Journal, New York City.
Explosive Service Bulletins, Wilmington, Del.
Fuel Oil, Chicago, Ill.
Fusion Facts, Whittier, Cal.
Graphite, Jersey City.
Grizzly Bear, Los Angeles.
Hercules Mixer, Wilmington, Del.
Industrial Employment Information Bulletin, Washington, D. C.
Lubrication, The Texas Co., New York City.
Mining Congress Journal, Washington, D. C.
Mining and Industrial Record, Vancouver, B. C.
Mining Journal, Phoenix, Arizona.
Mining and Metallurgy, New York City.
Mining Review, Salt Lake City.
Mining Truth, Spokane, Washington.
Mining Journal, London.
Monthly Review of Business Conditions, San Francisco.
National Sand and Gravel, Washington, D. C.
Oil Bulletin, Los Angeles.
Oil, Philadelphia, Pennsylvania.
Oil and Gas Journal, Tulsa, Oklahoma.
Oil, Paint and Drug Reporter, New York City.

Oil Weekly, Houston, Texas.
Pit and Quarry, Chicago.
Pacific Purchaser, San Francisco.
Petroleum Times, London, E. C. 2.
Petroleum World and Oil Age, Los Angeles.
Queensland Government Mining Journal, Brisbane, Australia.
Record, Associated Oil Co., San Francisco.
Rocks and Minerals, Peekskill, New York.
Rock Products, Chicago.
Scientific American, New York City.
Southwest Builder and Contractor, Los Angeles.
Standard Oil Bulletin, San Francisco.
Stone, New York City.
Through the Ages, Baltimore.

Newspapers.

The following papers are received and kept on file in the library:

Amador Dispatch, Jackson, California.
Barstow Printer, Barstow, California.
Beaumont Gazette, Beaumont, California.
Bridgeport Chronicle-Union, Bridgeport, California.
Calaveras Californian, Angels Camp, California.
California Oil World, Los Angeles, California.
Colusa Daily Sun, Colusa, California.
Daily Commercial News, San Francisco, California.
Daily Midway Driller, Taft, California.
Del Norte Triplicate, Crescent City, California.
Denver Mining Record, Denver, Colorado.
Exeter Sun, Exeter, California.
Goldfield News, Goldfield, Nevada.
Inyo Independent, Independence, California.
Inyo Register, Bishop, California.
Ione Valley Echo, Ione, California.
Las Vegas Age, Las Vegas, Nevada.
Livermore Herald, Livermore, California.
Mariposa Gazette, Mariposa, California.
Mercury Register, Oroville, California.
Mojave Miner, Kingman, Arizona.
Morning Union, Grass Valley, California.
Mountain Messenger, Downieville, California.
National Industrial Review, San Francisco, California.
Nevada City Nugget, Nevada City, California.
Nevada Mining Press, Reno, Nevada.
Oil Refinery News, Bayonne, New Jersey.
Petroleum Press, Taft, California.
Placer Herald, Auburn, California.
Plumas Independent, Quincy, California.
San Diego News, San Diego, California.
Shasta Courier, Redding, California.
Siskiyou News, Yreka, California.
Sotoyome Scimitar, Healdsburg, California.
Stockton Record, Stockton, California.
Tuolumne Prospector, Tuolumne, California.
Ventura County News, Ventura, California.
Waterford News, Waterford, California.
Weekly Trinity Journal, Weaverville, California.
Western Sentinel, Etna Mills, California.
Western Mineral Survey, Salt Lake City, Utah.

PRODUCERS AND CONSUMERS

The producer and consumer of mineral products are mutually dependent upon each other for their prosperity, and one of the most direct aids rendered by the Bureau to the mining industry in the past has been that of bringing producers and consumers into direct touch with each other.

This work has been carried on largely by correspondence, supplemented by personal consultation. Lists of buyers of all the commercial minerals produced in California have been made available to producers upon request, and likewise the owners of undeveloped deposits of various minerals, and producers of them, have been made known to those looking for raw mineral products.

When the publication of MINING IN CALIFORNIA was on a monthly basis, current inquiries from buyers and sellers were summarized and lists of mineral products or deposits 'wanted' or 'for sale' included in each issue.

It is important that inquiries of this nature reach the mining public as soon as possible and in order to avoid the delay incident to the present quarterly publication of MINING IN CALIFORNIA, these lists are now issued monthly in the form of a mimeographed sheet under the title of 'Commercial Mineral Notes,' and sent to those on the mailing list for MINING IN CALIFORNIA.

EMPLOYMENT SERVICE

Following the establishment of the Mining Division branch offices in 1919, a free technical employment service was offered as a mutual aid to mine operators and technical men for the general benefit of the mineral industry.

Briefly summarized, men desiring positions are registered, the cards containing an outline of the applicant's qualifications, position wanted, salary desired, etc., and as notices of 'positions open' are received, the names and addresses of all applicants deemed qualified are sent to the prospective employer for direct negotiations.

Telephone and telegraphic communications are also given immediate attention.

Technical men, or those qualified for supervisory positions, and vacancies of like nature only, are registered, as no attempt will be made to supply common mine and mill labor.

Registration cards for the use of both prospective employers and employees may be obtained upon request, and a cordial invitation is extended to the industry to make free use of the facilities afforded. Parties interested should communicate direct with our San Francisco office.

PUBLICATIONS OF THE DIVISION OF MINES

During the past forty-nine years, in carrying out the provisions of the organic act creating the former California State Mining Bureau, there have been published many reports, bulletins and maps which go to make up a library of detailed information on the mineral industry of the state, a large part of which could not be duplicated from any other source.

One feature that has added to the popularity of the publications is that many of them have been distributed without cost to the public, and even the more elaborate ones have been sold at a price which barely covers the cost of printing.

Owing to the fact that funds for the advancing of the work of this department have often been limited, many of the reports and bulletins mentioned were printed in limited editions which are now entirely exhausted.

Copies of such publications are available, however, in the office of the Division of Mines, in the Ferry Building, San Francisco; New Orpheum Building, Los Angeles; State Office Building, Sacramento; Redding; Santa Maria; Santa Paula; Coalinga; Taft; Bakersfield. They may also be found in many public, private and technical libraries in California and other states, and foreign countries.

A catalog of all publications from 1880 to 1917, giving a synopsis of their contents, is issued as Bulletin No. 77.

Publications in stock may be obtained by addressing any of the above offices and enclosing the requisite amount in the case of publications that have a list price. Only coin, stamps or money orders should be sent, and it will be appreciated if remittance is made in this manner rather than by personal check.

The prices noted include delivery charges to all parts of the United States. Money orders should be made payable to the Division of Mines.

NOTE.—The Division of Mines frequently receives requests for some of the early Reports and Bulletins now out of print, and it will be appreciated if parties having such publications and wishing to dispose of them will advise this office.

REPORTS

Asterisks (**) indicate the publication is out of print.

	Price
**First Annual Report of the State Mineralogist, 1880, 43 pp. Henry G. Hanks	----
**Second Annual Report of the State Mineralogist, 1882, 514 pp., 4 illustrations, 1 map. Henry G. Hanks	----
**Third Annual Report of the State Mineralogist, 1883, 111 pp., 21 illustrations. Henry G. Hanks	----
**Fourth Annual Report of the State Mineralogist, 1884, 410 pp., 7 illustrations. Henry G. Hanks	----
**Fifth Annual Report of the State Mineralogist, 1885, 234 pp., 15 illustrations, 1 geological map. Henry G. Hanks	----
**Sixth Annual Report of the State Mineralogist, Part I, 1886, 145 pp., 3 illustrations, 1 map. Henry G. Hanks	----
**Part II, 1887, 222 pp., 36 illustrations. William Irelan, Jr.	----
**Seventh Annual Report of the State Mineralogist, 1887, 315 pp. William Irelan, Jr.	----
**Eighth Annual Report of the State Mineralogist, 1888, 948 pp., 122 illustrations. William Irelan, Jr.	----
**Ninth Annual Report of the State Mineralogist, 1889, 352 pp., 57 illustrations, 2 maps. William Irelan, Jr.	----

REPORTS—Continued

Asterisks (**) indicate the publication is out of print.

	Price
**Tenth Annual Report of the State Mineralogist, 1890, 983 pp., 179 illustrations, 10 maps. William Irelan, Jr.	----
Eleventh Report (First Biennial) of the State Mineralogist, for the two years ending September 15, 1892, 612 pp., 73 illustrations, 4 maps. William Irelan, Jr.	$1.00
**Twelfth Report (Second Biennial) of the State Mineralogist, for the two years ending September 15, 1894, 541 pp., 101 illustrations, 5 maps. J. J. Crawford	----
**Thirteenth Report (Third Biennial) of the State Mineralogist, for the two years ending September 15, 1896, 726 pp., 93 illustrations, 1 map. J. J. Crawford	----
Chapters of the State Mineralogist's Report, Biennial Period, 1913–1914, Fletcher Hamilton:	
**Mines and Mineral Resources, Amador, Calaveras and Tuolumne Counties, 172 pp., paper	----
Mines and Mineral Resources, Colusa, Glenn, Lake, Marin, Napa, Solano, Sonoma and Yolo Counties, 208 pp., paper	.50
**Mines and Mineral Resources, Del Norte, Humboldt and Mendocino Counties, 59 pp., paper	----
**Mines and Mineral Resources, Fresno, Kern, Kings, Madera, Mariposa, Merced, San Joaquin and Stanislaus Counties, 220 pages, paper	----
**Mines and Mineral Resources of Imperial and San Diego Counties, 113 pp., paper	----
**Mines and Mineral Resources, Shasta, Siskiyou and Trinity Counties, 180 pp., paper	----
**Fourteenth Report of the State Mineralogist, for the Biennial Period 1913–1914, Fletcher Hamilton, 1915:	
A General Report on the Mines and Mineral Resources of Amador, Calaveras, Tuolumne, Colusa, Glenn, Lake, Marin, Napa, Solano, Sonoma, Yolo, Del Norte, Humboldt, Mendocino, Fresno, Kern, Kings, Madera, Mariposa, Merced, San Joaquin, Stanislaus, San Diego, Imperial, Shasta, Siskiyou and Trinity Counties, 974 pp., 275 illustrations, cloth	----
Chapters of the State Mineralogist's Report, Biennial Period, 1915–1916. Fletcher Hamilton:	
**Mines and Mineral Resources, Alpine, Inyo and Mono Counties, 176 pp., paper	----
Mines and Mineral Resources, Butte, Lassen, Modoc, Sutter and Tehama Counties, 91 pp., paper	.50
Mines and Mineral Resources, El Dorado, Placer, Sacramento and Yuba Counties, 198 pp., paper	.65
Mines and Mineral Resources, Monterey, San Benito, San Luis Obispo, Santa Barbara and Ventura Counties, 183 pp., paper	.65
**Mines and Mineral Resources, Los Angeles, Orange and Riverside Counties, 136 pp., paper	----
**Mines and Mineral Resources, San Bernardino and Tulare Counties, 186 pp., paper	----
**Fifteenth Report of the State Mineralogist, for the Biennial Period 1915–1916, Fletcher Hamilton, 1917:	
A General Report on the Mines and Mineral Resources of Alpine, Inyo, Mono, Butte, Lassen, Modoc, Sutter, Tehama, Placer, Sacramento, Yuba, Los Angeles, Orange, Riverside, San Benito, San Luis Obispo, Santa Barbara, Ventura, San Bernardino and Tulare Counties, 990 pp., 413 illustrations, cloth	----
Chapters of the State Mineralogist's Report, Biennial Period 1917–1918, Fletcher Hamilton:	
Mines and Mineral Resources of Nevada County, 270 pp., paper	.75
Mines and Mineral Resources of Plumas County, 188 pp., paper	.50
Mines and Mineral Resources of Sierra County, 144 pp., paper	.50
Seventeenth Report of the State Mineralogist, 1920, 'Mining in California during 1920,' Fletcher Hamilton; 562 pp., 71 illustrations, cloth	1.75
Eighteenth Report of the State Mineralogist, 1922, 'Mining in California,' Fletcher Hamilton. Chapters published monthly beginning with January, 1922:	

REPORTS—Continued

Asterisks (**) indicate the publication is out of print.

	Price
**January, **February, **March, **April, **May, **June, July, August, **September, October, November, December, 1922	Free
Chapters of Nineteenth Report of the State Mineralogist, 'Mining in California,' Fletcher Hamilton and Lloyd L. Root. January, February, March, September, 1923	Free
Chapters of Twentieth Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly. January, April, **July, October, 1924, per copy	$0.25
Chapters of Twenty-first Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly:	
January, 1925, Mines and Mineral Resources of Sacramento, Monterey and Orange Counties	.25
**April, 1925, Mines and Mineral Resources of Calaveras, Merced, San Joaquin, Stanislaus and Ventura Counties	.25
July, 1925, Mines and Mineral Resources of Del Norte, Humboldt and San Diego Counties	.25
October, 1925, Mines and Mineral Resources of Siskiyou, San Luis Obispo and Santa Barbara Counties	.25
Subscription, $1.00 in advance (by calendar year, only).	
Chapters of Twenty-second Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly:	
January, 1926, Mines and Mineral Resources of Trinity and Santa Cruz Counties	.25
April, 1926, Mines and Mineral Resources of Shasta, San Benito and Imperial Counties	.25
July, 1926, Mines and Mineral Resources of Marin and Sonoma Counties	.25
October, 1926, Mines and Mineral Resources of El Dorado and Inyo Counties, also report on Minaret District, Madera County	.25
Chapters of Twenty-third Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly:	
January, 1927, Mines and Mineral Resources of Contra Costa County; Santa Catalina Island	.25
April, 1927, Mines and Mineral Resources of Amador and Solano Counties	.25
July, 1927, Mines and Mineral Resources of Placer and Los Angeles Counties	.25
October, 1927, Mines and Mineral Resources of Mono County	.25
Chapters of Twenty-fourth Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly:	
January, 1928, Mines and Mineral Resources of Tuolumne County	.25
April, 1928, Mines and Mineral Resources of Mariposa County	.25
**July 1928, Mines and Mineral Resources of Butte and Tehama Counties	----
October, 1928, Mines and Mineral Resources of Plumas and Madera Counties	.25
Chapters of Twenty-fifth Report of the State Mineralogist, 'Mining in California,' Walter W. Bradley. Published quarterly:	
January, 1929, Mines and Mineral Resources of Lassen, Modoc and Kern Counties; also on Special Placer Machines	.25
April, 1929, Mines and Mineral Resources of Sierra, Napa, San Francisco and San Mateo Counties	.25
July, 1929, Mines and Mineral Resources of Colusa, Fresno and Lake Counties	.25
October, 1929, Mines and Mineral Resources of Glenn, Alameda, Mendocino and Riverside Counties	.25
Chapters of Twenty-sixth Report of the State Mineralogist 'Mining in California', Walter W. Bradley. Published quarterly:	
January, 1930, Mines and Mineral Resources of Santa Clara County; also Barite in California	.25
April, 1930, Mines and Mineral Resources of Nevada County; also Mineral Paint Materials in California	.25
July, 1930, Mines and Mineral Resources of Yuba and San Bernardino Counties; also Commercial Grinding Plants in California	.25
Chapters of State Oil and Gas Supervisor's Report:	
Summary of Operations—California Oil Fields, July, 1918, to March, 1919 (one volume)	Free
Summary of Operations—California Oil Fields. Published monthly, beginning April, 1919:	

REPORTS—Continued

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	Price
**April, **May, June, **July, **August, **September, **October, November, **December, 1919	Free
January, February, March, April, **May, June, July, **August, September, October, November, December, 1920	Free
January, **February, **March, **April, May, June, **July, August, **September, **October, **November, **December, 1921	Free
January, February, March, April, May, June, July, August, September, October, November, December, 1922	Free
January, February, March, April, May, June, July, August, September, October, November, December, 1923	Free
January, February, March, April, May, June, July, August, September, October, November, December, 1924	Free
January, February, March, April, May, June, July, August, September, October, November, December, 1925	Free
January, February, March, April, May, June, July, August, September, October, November, December, 1926	Free
January, February, March, April, May, June, July, August, September, October, November, December, 1927	Free
January, February, March, April, May, June, July, 1928	Free

BULLETINS

**Bulletin No. 1. A Description of Some Desiccated Human Remains, by Winslow Anderson. 1888, 41 pp., 6 illustrations	----
**Bulletin No. 2. Methods of Mine Timbering, by W. H. Storms. 1894, 58 pp., 75 illustrations	----
**Bulletin No. 3. Gas and Petroleum Yielding Formations of Central Valley of California, by W. L. Watts. 1894, 100 pp., 13 illustrations, 4 maps	----
**Bulletin No. 4. Catalogue of Californian Fossils, by J. G. Cooper, 1894, 73 pp., 67 illustrations. (Part I was published in the Seventh Annual Report of the State Mineralogist, 1887.)	----
**Bulletin No. 5. The Cyanide Process, 1894, by Dr. A. Scheidel. 140 pp., 46 illustrations	----
**Bulletin No. 6. California Gold Mill Practices, 1895, by E. B. Preston, 85 pp., 46 illustrations	----
**Bulletin No. 7. Mineral Production of California, by Counties, for the year 1894, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 8. Mineral Production of California, by Counties, for the year 1895, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 9. Mine Drainage, Pumps, etc., by Hans C. Behr. 1896, 210 pp., 206 illustrations	----
**Bulletin No. 10. A bibliography Relating to the Geology, Palæontology and Mineral Resources of California, by Anthony W. Vogdes. 1896, 121 pp.	----
**Bulletin No. 11. Oil and Gas Yielding Formations of Los Angeles, Ventura and Santa Barbara Counties, by W. L. Watts. 1897, 94 pp., 6 maps, 31 illustrations	----
**Bulletin No. 12. Mineral Production of California, by Counties, for 1896, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 13. Mineral Production of California, by Counties, for 1897, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 14. Mineral Production of California, by Counties, for 1898, by Charles G. Yale	----
**Bulletin No. 15. Map of Oil City Fields, Fresno County, by John H. Means. 1899	----
**Bulletin No. 16. The Genesis of Petroleum and Asphaltum in California, by A. S. Cooper. 1899, 39 pp., 29 illustrations	----
**Bulletin No. 17. Mineral Production of California, by Counties, for 1899, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 18. Mother Lode Region of California, by W. H. Storms. 1900, 154 pp., 49 illustrations	----
**Bulletin No. 19. Oil and Gas Yielding Formations of California, by W. L. Watts. 1900, 236 pp., 60 illustrations, 8 maps	----

BULLETINS—Continued

Asterisks (**) indicate the publication is out of print.

Price

**Bulletin No. 20. Synopsis of General Report of State Mining Bureau, by W. L. Watts. 1901, 21 pp. This bulletin contains a brief statement of the progress of the mineral industry in California for the four years ending December, 1899 ----

**Bulletin No. 21. Mineral Production of California by Counties, by Charles G. Yale. 1900. Tabulated sheet ----

**Bulletin No. 22. Mineral Production of California for Fourteen Years, by Charles G. Yale. 1900. Tabulated sheet ----

Bulletin No. 23. The Copper Resources of California, by P. C. DuBois, F. M. Anderson, J. H. Tibbits and G. A. Tweedy. 1902, 282 pp., 69 illustrations, 9 maps $0.50

**Bulletin No. 24. The Saline Deposits of California, by G. E. Bailey. 1902, 216 pp., 99 illustrations, 5 maps ----

**Bulletin No. 25. Mineral Production of California, by Counties, for 1901, by Charles G. Yale. Tabulated sheet ----

**Bulletin No. 26. Mineral Production of California for the Past Fifteen Years, by Charles G. Yale. 1902. Tabulated sheet ----

**Bulletin No. 27. The Quicksilver Resources of California, by William Forstner. 1903, 273 pp., 144 illustrations, 8 maps ----

**Bulletin No. 28. Mineral Production of California for 1902, by Charles G. Yale. Tabulated sheet ----

**Bulletin No. 29. Mineral Production of California for Sixteen Years, by Charles G. Yale. 1903. Tabulated sheet ----

**Bulletin No. 30. Bibliography Relating to the Geology, Palæontology and Mineral Resources of California, by A. W. Vogdes. 1903, 290 pp. ----

**Bulletin No. 31. Chemical Analyses of California Petroleum, by H. N. Cooper. 1904. Tabulated sheet ----

**Bulletin No. 32. Production and Use of Petroleum in California, by Paul W. Prutzman. 1904, 230 pp., 116 illustrations, 14 maps ----

**Bulletin No. 33. Mineral Production of California, by Counties, for 1903, by Charles G. Yale. Tabulated sheet ----

**Bulletin No. 34. Mineral Production of California for Seventeen Years, by Charles G. Yale. 1904. Tabulated sheet ----

**Bulletin No. 35. Mines and Minerals of California, by Charles G. Yale. 1904, 55 pp., 20 county maps. Relief map of California ----

**Bulletin No. 36. Gold Dredging in California, by J. E. Doolittle. 1905. 120 pp., 66 illustrations, 3 maps ----

**Bulletin No. 37. Gems, Jewelers' Materials, and Ornamental Stones of California, by George F. Kunz. 1905, 168 pp., 54 illustrations ----

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DETERMINATION OF MINERAL SAMPLES

Samples (limited to three at one time) of any mineral found in the State may be sent to the Division of Mines for identification, and the same will be classified free of charge. No samples will be determined if received from points outside the State. It must be understood that no assays, or quantitative determinations will be made. Samples should be in lump form if possible, and marked plainly with name of sender on outside of package, etc. No samples will be received unless delivery charges are prepaid. A letter should accompany sample, giving locality where mineral was found and the nature of the information desired.

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